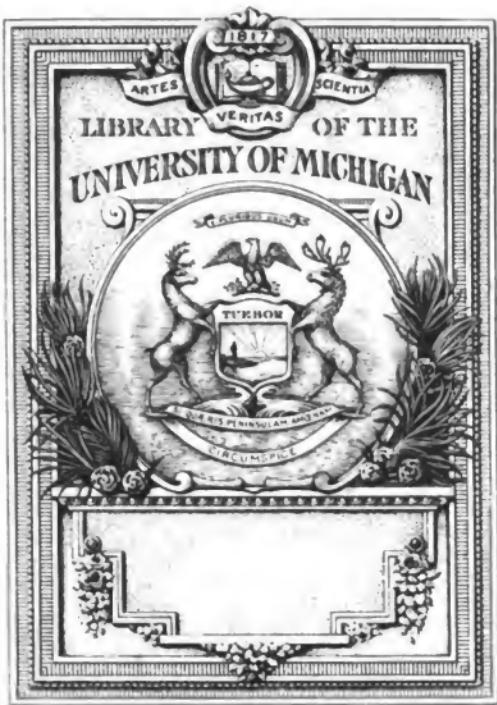


THE AQUARIUM

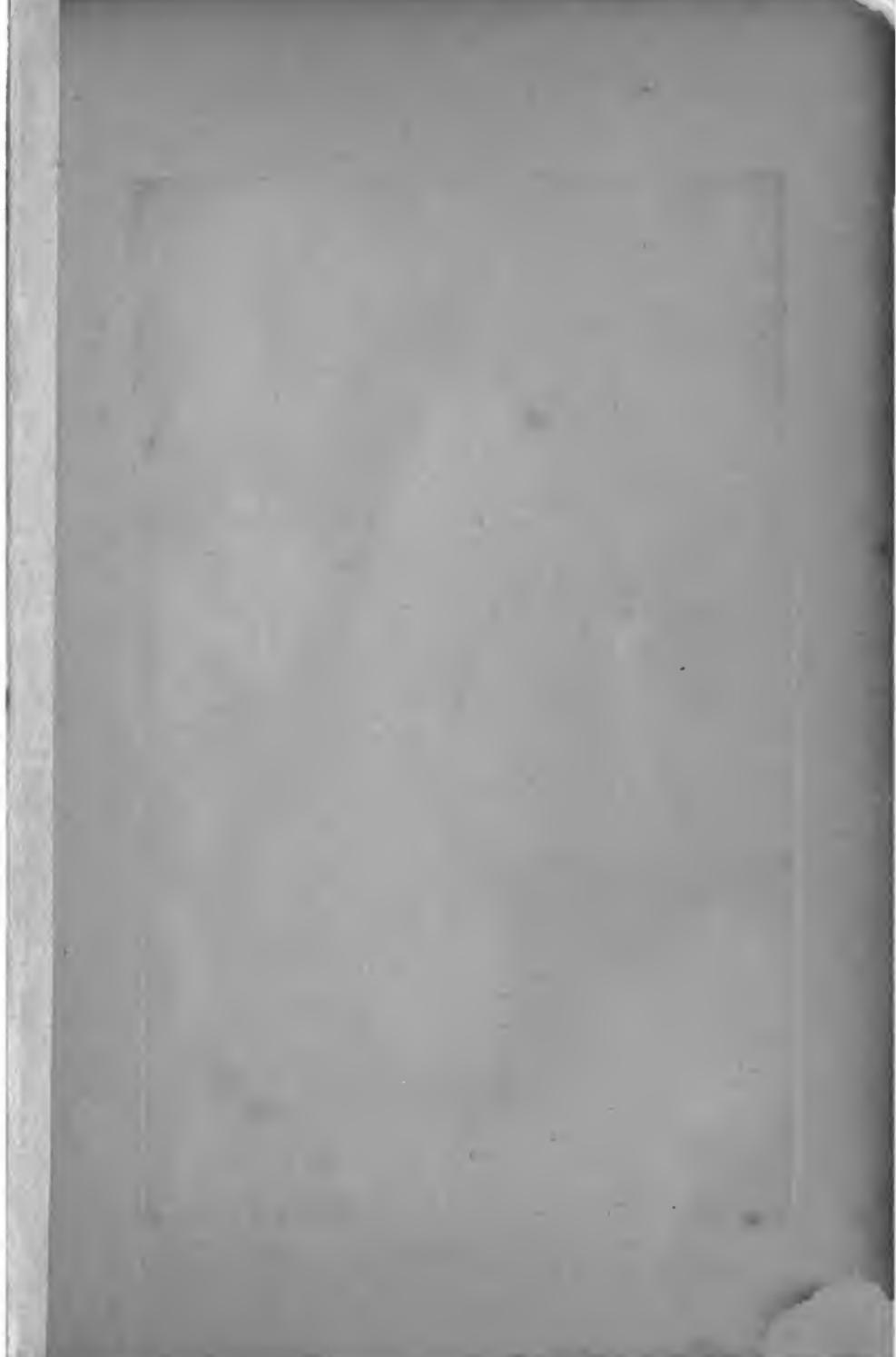
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THE ANCIENT WRASSE.

P. H. Gosse, Del.

THE

A Q U A R I U M :



AN UNVEILING OF THE

WONDERS OF THE DEEP SEA.

BY

PHILIP HENRY GOSSE, F.R.S.
=

“The sea is His, and He made it.”—*Ps. xcvi. 5.*

Second Edition, Revised and Enlarged.

LONDON :

JOHN VAN VOORST, PATERNOSTER ROW.

M DCCC LVI.

P R E F A C E.

THE habits of animals will never be thoroughly known till they are observed in detail. Nor is it sufficient to mark them with attention now and then ; they must be closely watched, their various actions carefully noted, their behaviour under different circumstances, and especially those movements which seem to us mere vagaries, undirected by any suggestive motive or cause, well examined. A rich fruit of result, often most curious and unexpected, and often singularly illustrative of peculiarities of structure, will, I am sure, reward any one who studies living animals in this way. The most interesting parts, by far, of published natural history, are those minute, but most graphic particulars, which have been gathered by an attentive watching of individual animals. Many examples crowd up to my mind ;—Wilson's picture of the Mocking-bird ; Vigors's of the Toucan ; Broderip's of his Beaver "Binny;" Dovaston's of the Water-shrew ; Bennett's of the Bird of Paradise, and multitudes more.

It is true that observations of this kind make us acquainted rather with an individual than with a species; and long experience has convinced me that this is not a distinction without a difference. There is an idiosyncrasy in the inferior animals, I am persuaded,—not so great or varied, probably, as in Man, since the more highly any faculty is developed, the more susceptible it is of modification; but—sufficient to communicate individuality of character, and to make the actions of one animal to differ, in some degree, from those of another of the same species, under similar circumstances. We commonly think of the features of one Deer, or Sparrow, or Crab, as exact counterparts of those of every other Deer, or Sparrow, or Crab; yet a shepherd is able to distinguish every Sheep of his flock by its face; those who are conversant with Horses can readily detect diversities in the expression of their eye or mouth, scarcely less marked than in their human acquaintances; and I have myself noticed the same distinctness in birds. When I was in Jamaica, I could tell one from another of the wild Doves in my cages, by their expression of countenance alone, though perfectly alike in colouring. Doubtless this individuality would be much more generally perceived, if our observations on animals were not so loose and cursory as they usually are. And if it exists in the *features*, we might reasonably infer in them a parallel diversity in *mind* (by which I mean a faculty distinct from,

but coexistent with, instinct), even if direct observation did not detect it.

But, bearing in mind that records thus obtained of the manners of animals are properly biographical,—belonging to the individual more strictly than to the species,—it is manifest that these must be the foundation of all our correct generalization. Nor are they in themselves unworthy of careful regard, as those will allow who know the value of human Biography. Shakspeare and Scott, who treat of man as an individual, are not inferior in their walk of science to Reid and Stewart, who describe him as a species.

The inhabitants of the deep sea have hitherto been almost inaccessible to such observation as this; and hence exceedingly little has been accumulated of their Biography. A paragraph went the round of the papers some months ago, to the effect that an eminent French zoologist, in order to prosecute his studies on the marine animals of the Mediterranean, had provided himself with a water-tight dress, suitable spectacles, and a breathing-tube; so that he might walk on the bottom in a considerable depth of water, and mark the habits of the various creatures pursuing their avocations.

Whether a scheme so elaborate was really attempted I know not; but I should anticipate feeble results from it. The MARINE AQUARIUM, however, bids fair to supply the required opportunities, and to make us acquainted with the strange creatures of the sea,

without diving to gaze on them. In this volume I offer to the world a small earnest, just the first-fruits, of what may be looked for in increased knowledge of natural history from this invention.

In some respects the present volume may be considered a sequel and continuation of my "Rambles on the Devonshire Coast:" inasmuch as it is conversant with similar objects, and as I have made it assume somewhat of the form of a personal narrative; sufficient, at least, to constitute a link of connexion between myself and my reader, not only in the *things* described, but also in the feelings they excite in my own mind.

But the subjects of the present work are principally deep-sea animals, as those of the former were chiefly littoral; and even where the sphere of observation is the same, the observations themselves are quite distinct, and have to do with different creatures. A certain degree of family likeness must prevail in all out-of-door natural history; but so vast, and almost illimitable, is the field of labour, that industry and faithfulness will always be rewarded by fresh and interesting results.

The following pages embrace a brief History of the Marine Aquarium, as an application of scientific principles to a definite object;—my own experience in collecting animals and plants, with instructions founded thereon;—copious details of the peculiar habits and instincts of such species as I have observed

in confinement;—sketches of scenery, of local customs and manners, and of personal adventure, made during the prosecution of the employment; and, finally, an arranged chapter of directions for the construction, preparation, stocking, and maintenance of a Marine Aquarium.

The Plates which illustrate this volume are its principal peculiarity. I have endeavoured—in a manner hitherto, I believe, unattempted—to represent marine animals, with their beauty of form and brilliance of colour, in their proper haunts, surrounded by submarine rocks and elegant sea-weeds, as these appear when transferred to an Aquarium. They have been printed from stone by Messrs. Hanhart, who have not spared all the resources of that beautiful art of which they are the acknowledged masters, in reproducing my original drawings.

The wood-engravings are by Messrs. Whymper, and represent the Coast-scenery in the vicinity of Weymouth.

P. H. G.

LONDON: *April*, 1854.

P R E F A C E
TO THE SECOND EDITION.

MANY notes have been added to the text in this Edition: the whole has been carefully revised; and the Chapter of Directions, in particular, has been greatly augmented, and almost re-written. The work is thus brought down to the present state of our knowledge on the subject.

P. H. G.

LONDON: *August*, 1856.

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THE AQUARIUM.

CHAPTER I.

APRIL is come at last. The arctic frosts, dreadful and protracted as they were, of February and March, that chilled the very life out of my poor cherished Actinias, and left me mourning over empty vases, have at last passed away, and here are the sweet, soft, south-west breezes of April. And now farewell to grimy, smoky London, and down, down to Dorsetshire, as swiftly as the panting engine can drag us.

What a change have twenty-four hours made! We raise the blind from our bed-room window, and instead of a forest of chimneys in the distance, and a mews in the foreground, with grooms currying horses that won't stand still, we gaze out upon the magnificent Bay of Weymouth; for our lodgings are on the ridge that they call the Lookout, with the sea below us breaking at the foot of the cliff.

The expanse before us has been described as second only to the beautiful Bay of Naples, by those who have seen both. I have not, and therefore cannot vouch

for the justice of the comparison ; but certainly *this* is a glorious prospect. It is a lovely morning ; the sun has not been long up, but his effulgence fills the sky with splendour immediately in front, a splendour which trails along the intervening sea, as if it were the fiery monarch's train.* Away on the left stretch the bold promontories and abrupt cliffs of Purbeck, twenty miles of purple coast, gradually lessening in apparent height, and in distinctness of outline, until the bluff precipice that terminates the line, St. Aldhelm's Head, is lost in the brightness of the eastern horizon. Then the broad expanse of boundless sea brings the eye to Portland on the right, a lofty rounded mass, thrown out into strong light by the opposite sunbeams, and to that noble work the Breakwater, as noble in design and object as marvellous in execution, which perpetually creeps out into the domain of the sea, presenting an effectual though scarcely visible wall to the waves, until by and by it shall stretch halfway across our present field of view, and enclose a safe harbour of refuge, on which many a mariner will bestow his grateful blessing. At such a time as this sweet April morning, indeed, a work like this may seem of little value, when the waves of the ocean only just suffice to break its face into gems of changing brilliance, and to make whispering music ; while vessels of all sizes, like those whose clustering masts we see yonder under the promontory, ride with perfect security in the open road. But in the fierce gales of

* "Where like an Angel's train
The burnish'd water blazed." (KEBLE.)

November or March, when the shrieking blasts drive furiously up the Channel, and the huge mountain-billows, green and white, open threatening graves on every side, how welcome would be a safe harbour, easy of access, and placed at a part of the coast which else would be unsheltered for many leagues on either side ! Blessed be God for the gift of his beloved Son, the only Harbour of Refuge for poor tempest-tossed sinners ! We may think lightly of it now, but in the coming day of gloom and wrath, when “the rain descends, and the floods come, and the winds blow,” they only will escape who are sheltered there !

This visit to Weymouth was immediately connected with the Marine Aquarium. Those of my readers who have honoured my “Rambles on the Devonshire Coast” with their perusal, may remember the experiments I have there recorded, on the making of such an invention practicable in London, and other inland towns, and my anticipations of success. Early in December, 1852, I put myself into communication with the Secretary of the Zoological Society, and the result was the transfer of a small collection of Zoophytes and Annelides, which I had brought up from Ilfracombe, and which I had kept for two months in vases in London,—to one of the tanks in the new Fish House just erected in the Society’s Gardens in the Regent’s Park. This little collection thus became the nucleus and the commencement of the Marine Aquarium afterwards exhibited there.

It was in consequence of an engagement to supply

with marine inhabitants the other tanks which the Zoological Society proposed to devote to this object that I proceeded again to the coast. The prosecution of that employment during the months of May, June, and July, in the course of which upwards of five thousand specimens of animals and plants passed through my hands, made me acquainted with many curious facts in their economy and habits, and with many interesting traits in their history, which are not recorded (so far as I am aware) in works of science.

The facilities for observation thus afforded me have been augmented by means of Aquaria of various forms and sizes, which I have had made for my own private use, and of which I shall have occasion to speak in the following pages. In them I could mark with leisure and precision the manners of the creatures that were living *at home*, yet constantly under my eye.

Considering the novelty and curiosity of the exhibition thus offered to the public, and the popularity which it achieved, it may not be uninteresting to treat of a few of the more prominent objects in detail, and of the modes in which they were collected. We generally feel an interest in knowing somewhat of the antecedents of any person or thing that strongly attracts our attention; and in the present case more than idle curiosity may be gratified, since the record of my experiences may be useful to others in forming similar collections, either for public exhibition or for private study.

The idea of maintaining the balance between animal and vegetable life on chemical principles is not quite

so novel as I had at first supposed. Priestley first advanced the opinion that plants in certain circumstances emitted oxygen gas ; and Ingenhousz soon after discovered that the leaves of plants, when immersed in water, and exposed to the light of day, produced an air, which he announced as oxygen gas. This result, however, was doubted by Ellis, in his elaborate treatise on Atmospheric Air, and, as he considered, disproved.* The consumption of oxygen by animals in respiration, and the emission of carbonic acid from the lungs and skin, were well shown by this writer, who maintained, however, that this latter gas was also emitted by the leaves of plants.†

At the third meeting of the British Association, held at Cambridge in 1833, Professor Daubeny communicated a notice of certain researches which he was then pursuing, concerning the action of light upon plants, and that of plants upon the atmosphere. "He considered that he had established, by experiments on plants immersed, sometimes *in water* impregnated with carbonic acid gas, and at others in atmospheric air containing a notable proportion of the same, that the action of light in promoting the discharge of certain of their functions, and especially that of the decomposition of carbonic acid, is dependent neither upon the heating, nor yet upon the chemical energy of the several rays, but upon their illuminating power.

" He regarded light as operating upon the green parts of plants as a specific stimulus, calling into action, and keeping alive those functions, from which

* Inquiry, &c. p. 57—60.

† Ib. p. 203, *et passim*.

the assimilation of carbon and the evolution of oxygen
result. . . .

"He had satisfied himself that in fine weather a plant consisting chiefly of leaves and stem will, if confined in the same portion of air night and day, and duly supplied with carbonic acid during the sunshine, go on *adding to the proportion of oxygen* present, so long as it continues healthy, at least up to a certain point. . . .

"Considering the quantity of oxygen generated by a very small portion of a tree or shrub introduced, he saw no reasons to doubt that *the influence of the vegetable might serve as a complete compensation for that of the animal kingdom.*"

In 1837, Mr. Ward made a Report to the British Association, "On the Growth of Plants in closed Cases," at the end of which he "directed the attention of the members to the development of animal life upon the same principles." He was "quite certain that a great number of animals would live and thrive under this treatment."

In his treatise on the same subject, published in 1842, he dilates a little on this matter, chiefly with regard to increasing the purity of air for breathing in large towns, as a remedy for disease. "The difficulty to be overcome," he observes, "would be the removal or neutralization of the carbonic acid given out by animals; but this in the present state of science could easily be effected, either by ventilators or by the growth of plants in connexion with the air of the room, *so that the animal and vegetable respirations might counterbalance each other.* The volume of the

air, with the quantity of vegetable matter required, as compared with the size and rank in creation of the animal, would be a problem well worthy of solution."*

In the same year (1842) Dr. Johnston published his "History of British Sponges and Lithophytes;" in which, arguing out the vegetability of the latter, he mentioned in a note what is the most germane of all to our purpose,—the actual formation of a little Marine Aquarium. To Dr. Johnston therefore, as I think, must be assigned the honour of the first accomplishment of this object.† His words are as follows:—

* On the Growth of Plants, p. 73.

† Since the publication of the first edition of this Work, other competitors for the honour of having first invented the Aquarium have appeared. In a lecture delivered before the Royal Institution, by Dr. S. H. Ward, the following statements occur:—"Mr. Ward, in 1841, established, in a capacious earthenware vessel, an Aquarium for fish and plants. In this vessel, which contained twenty gallons of water, and which he surrounded with rock-work raised several feet above its margin, he placed gold and silver fish, in company with several aquatic plants, viz., *Valisneria spiralis*, *Pontederia crassipes*, *Pistia stratiotes*, and *Papyrus elegans*. In this miniature lake, the water of which was never changed, but kept in a constantly pure state by the action of the associated plants, the animals lived in a healthy condition for many years." "The individual to whom is due the merit of having introduced marine vivaria into London is Mrs. Thynne. Having procured some living madrepores when at Torquay, in the autumn of 1846, she placed them in some sea-water in a bottle covered with a bladder, and brought them safely to town. They were then transferred to two glass bowls, the sea-water being kept aerated by being daily poured backwards and forwards, and being, moreover, periodically renewed by a fresh supply from the coast. In the spring of 1847, Mrs. Thynne sent for some pieces of rock, shell, &c. to which living sea-weeds were attached, and subsequently depended upon the action of these for the purification of the water." Mrs. Thynne has kindly favoured me with a perusal of her observations, which not only prove her to have succeeded in maintaining a self-supporting Aquarium, but are of the highest interest in a physiological view.—(Second Edition.)

"Was there a need of adding any additional proof of the vegetability of the Corallines, an experiment now before me would seem to supply it. It is now eight weeks ago since I placed in a small glass jar, containing about six ounces of pure sea-water, a tuft of the living *Corallina officinalis*, to which were attached two or three minute *Confervæ*, and the very young frond of a green *Ulva*; while numerous *Rissoœ*, several little Mussels and Annelides, and a Star-fish were crawling amid the branches. The jar was placed on a table, and was seldom disturbed, though occasionally looked at; and at the end of four weeks, the water was found to be still pure, the Mollusca and other animals all alive and active, the confervæ had grown perceptibly, and the coralline itself had thrown out some new shoots, and several additional articulations. Eight weeks have now elapsed since the experiment was begun,—the water has remained unchanged,—yet the coralline is growing, and apparently has lost none of its vitality; but the animals have sensibly decreased in numbers, though many of them continue to be active, and show no dislike to their situation. What can be more conclusive? I need not say that if any animal, or even a sponge, had been so confined, the water would long before this time have been deprived of its oxygen, would have become corrupt and ammoniacal, and poisonous to the life of every living thing."*

On the 4th of March, 1850, at a meeting of the Chemical Society, Mr. Robert Warington communi-

* Op. cit.; p. 215.

cated the results of an experiment which he had been prosecuting for nearly a year, "On the adjustment of the relations between the animal and vegetable kingdoms, by which the vital functions of both are permanently maintained." Two small gold fish were placed in a glass receiver of about twelve gallons' capacity, covered with thin muslin to exclude dust and soot. The vessel was half filled with spring water, with a bottom of sand and mud, and some loose fragments of limestone and sandstone, so arranged as to afford shelter and shade. A small specimen of *Valisneria spiralis* was at the same time planted in the mud, and kept in place by a stone. The whole was then left undisturbed.

Everything went on well for a time, till it was found that the natural decay of the older leaves of the plant began to produce turbidity in the water, and a confervoid growth accumulated on the sides of the vessel, and on the surface of the water. To meet this emergency, Mr. Warington introduced a few common Pond-snails (*Limnea*), which greedily fed on the decaying vegetable matter and slimy mucous growth, so as quickly to restore the whole to a healthy state.

The result was now quite satisfactory. The plant thrived and increased greatly by offshoots and suckers; the fishes continued to preserve their health and beauty, while the snails deposited enormous masses of eggs; thus supplying food for the fishes, as well as performing the office of scavengers.

Thus the success of the experiment was established, and an Aquarium was formed in fresh water; which has continued to prosper to the present time:

the animals and plants maintaining each other in healthy life, and the water preserving its purity unchanged.

In January, 1852, Mr. Warington began to prosecute experiments of the same kind with sea-water, which presented some difficulties arising from the compound nature of that fluid, and from the peculiarities of marine vegetation. These difficulties, however, yielded to the perseverance and skill of the operator; and while I write these lines I am a personal witness to his complete success, having just seen (January, 1854) specimens of Sea-anemones and other marine animals in good health in that gentleman's Aquarium, which I know were sent from the sea-side more than a year and a quarter ago.

A Memoir by Mr. Warington, which appeared in the "Annals of Natural History" for November, 1853, gives some very interesting details of the progress of the marine experiments; and from it I shall make a few extracts.

"The sea-water with which the experiments were conducted, was obtained through the medium of one of the oyster-boats at the Billingsgate fish-market, and was taken from the middle of the English Channel.

"My first object was to ascertain the kind of seaweed best fitted, under ordinary circumstances, for keeping the water clear and sweet, and in a sufficiently oxygenated state to sustain animal life. And here opinions were at variance, for one naturalist friend, whom I consulted, advised me to employ the Rhodospersms; another stated that it was impossible to make

the red weeds answer the purpose, as he had tried them, and strongly recommended the olive or brown-coloured Algae; while, again, others thought that I should be more successful with those which had in theory first suggested themselves to my own mind, namely, the Chlorosperms. After making numerous unsuccessful experiments with both the brown and the red varieties of Algae, I was fully convinced that the green weeds were the best adapted for the purpose.

"This point having been practically ascertained, and some good pieces of the *Enteromorpha* and *Ulva latissima* in a healthy state, attached to nodules of flint or chalk, having been procured from the shore near Broadstairs, several living animal subjects were introduced, together with the periwinkle. Everything progressed satisfactorily, and these all continued in a healthy and lively condition.

"My first trials were conducted in one of the small tanks which had been used for fresh water; but as it was necessary, during the unsuccessful experiments with the brown and red sea-weeds to agitate and aerate the water, which had been rendered foul from the quantity of mucus or gelatinous matter generated during the decay of their fronds, until the whole had become oxidized, and the water rendered clear and fitted for another experiment, it was, therefore, for greater convenience, removed into a shallow earthen pan, and covered with a large glass shade to protect the surface of the water, as much as possible, from the dust and soot of the London atmosphere, and at the same time impede the evaporation. In this

vessel then I had succeeded perfectly in keeping a large number of beautiful living specimens in a healthy condition up to the close of 1852. I therefore gave instructions for the making of a small tank as a more permanent reservoir, and one more adapted for carrying on my observations and investigations on the economy and habits of the inhabitants.

"From the experience I had obtained in my experiments with the fresh-water tank, I was induced to modify slightly the construction of this vessel; thus, at the back, or part towards the light, the framing was filled with slate in the same way as the ends and bottom; for I had found that the glass, originally employed, very soon became covered with a conervoid growth which had an unpleasing appearance to the eye, and in consequence of which I had been obliged to paint the glass on the exterior to prevent this growth from increasing to too great an extent. It was also an unnatural mode of illumination, as all the light should pass through the surface of the water. The front towards the room and the observer was constructed of plate glass, the whole being set in a stout framework of zinc, and cemented with what is known under the name of Scott's cement, and which I have found to answer for the purpose most admirably. Within this tank were arranged several large pieces of rock-work, thrown into an arched form, and other fragments were cemented in places against the slate at the back and ends, and at parts along the water-line, so that the creatures could hide themselves at pleasure; a short beach of pebbles was also constructed in order that shallow water could be resorted

to if desired. The whole tank was covered with a light glass shade to keep out the dust, and retard evaporation.

"With the sea-water obtained in January, 1852, I have been working without cessation up to the present time, agitating and aërating when it became foul during the unsuccessful experiments on the sea-weeds, but since then it has been rarely ever disturbed; the loss which takes place from evaporation being made up, as before stated, with rain or distilled water."

My own experiments with marine animals and plants were commenced about the same time as Mr. Warington's; namely, at the end of January, 1852. I was not aware till long afterwards that either that gentleman or any one else had proposed to effect such an object, which had been occupying my mind for some time. My success, which was less perfect than Mr. Warington's, I published in the "Annals of Natural History" for October, 1852, and subsequently in my "Rambles on the Devonshire Coast." Travelling for health, the want of a fixed residence prevented my prosecuting my experiments with sufficient care and perseverance to ensure full success; besides which, my ultimate object was rather the study of the habits of marine animals, to which end the Marine Aquarium was merely (or at least principally) accessory.

CHAPTER II.

The love of Nature's works
Is an ingredient in the compound, man,
Infused at the creation of the kind.
And, though th' Almighty Maker has throughout
Discriminated each from each, by strokes
And touches of his hand, with so much art
Diversified, that two were never found
Twins at all points—yet this obtains in all,
That all discern a beauty in his works,
And all can taste them.—COWPER.

THE first thing I always do when I get into a new locality, is to walk round to reconnoitre ; to take a general view of the hunting ground. This examination I almost always find necessary to make for myself; it is astonishing how little information one can get from persons of the greatest intelligence and general knowledge, and of a life's familiarity with the place, when we ask them for details that they have not had occasion to study. The nature of the shore here or there, what sort of surface is exposed at low water, how far the sea recedes from the cliffs, where tide-pools are to be found, where sea-weeds grow most abundantly,—these are inquiries which do not seem to demand an intimate acquaintance with technical natural history to be answered ; and yet of the inha-

bitants of any seaport town, not one in a thousand would be able to give you satisfaction about them, unless you happen to meet with a practical working naturalist who has searched up the neighbourhood. You must use your own eyes.

I accordingly took a walk around the shore, from the Lookout southward ; making my way down the sloping cliff, which successive landslips have crumbled down and rent into chasms in the grassy turf, threatening at no very distant period the fall of the pretty cottages above, that already stand in perilous proximity to the falling edge. The beach below, sweeping round to Belmont Bay, is loose shingle, most unpleasant and fatiguing to walk over, and one of the most unproductive to the naturalist. Between tide-marks the pebbles are washed clean by the surf; but along the line of high-water, there is here a broad bank of black sea-grass (*Zostera*), the accumulation of years, perhaps ages, rotting into mould, and forming an admirable manure. It is indeed used for this purpose, being carted away by the farmers when it is sufficiently abundant and sufficiently accessible. In the vicinity of Torquay and of Ilfracombe, I had not met with this substance in any appreciable quantity ; but in Poole Harbour, the scene of my early life, I had been familiar enough with it, as its dirty, littering banks, like a continuous dunghill, fringe the shores ; the refuse of hundreds of acres of the grass, that grows on the muddy flats of that land-locked harbour.

Nor was this the only thing that reminded me of early days. As I sauntered with downcast eyes over the shingle, my eye caught a perforated pebble, and

in an instant the rude distich of boyish days came up to my recollection, and I involuntarily repeated—

“Lucky stone ! lucky stone ! go over my head,
And bring me some good luck before I go to bed !”

For it was one of the superstitions of my childhood, taught and believed by credulous schoolfellows, that the boy who found such a perforated stone, and threw it over his head with the above doggerel rhyme, would not fail to reap a swift harvest of “luck.” What a strange faculty is memory ! I had not thought of this rhyme nor of its associations for perhaps thirty years ; and yet the sight of the pebble brings up the perfect recollection, as if it had been only yesterday that I had played at canal-digging and boat-sailing on Westbutts shore ! Perhaps nothing, be it good, bad, or indifferent (especially the latter two), is really *lost* when once the mind has apprehended it ; so lost as that it may not be recalled, voluntarily or involuntarily, by some association or other, at some time or other. And possibly in eternity, when God will bring every secret thing to judgment, we may find everything perfectly presented to our remembrance that has ever occurred to us, with all its causes, results, and connexions. “For there is nothing covered, that shall not be revealed ; and hid that shall not be known.” Terrible, indeed, would be the anticipation of such an unveiling of the past, were it not for the blood of the Great Atoning Lamb of God, in which the guiltiest conscience may find refuge.

Standing here once more at the verge of the sea, with its gentle waves kissing my feet, about to resume,

after the dreariness of winter, those studies of the works of God which are so delightful, my mind was powerfully struck with that Almighty decree which, amidst continual change, maintains an everlasting order. Man grows old, but Nature is ever young ; the seasons change, but are perpetually renewed :— “ While the earth remaineth, seedtime and harvest, and cold and heat, and summer and winter, and day and night shall not cease.” Beautifully has the American poet sung of this :—

“ Has Nature in her calm majestic march
 Falter’d with age at last ? does the bright sun
 Grow dim in heaven ? or in their far blue arch,
 Sparkle the crowd of stars when day is done
 Less brightly ? When the dew-lipp’d Spring comes on,
 Breathes she with airs less soft, or scents the sky
 With flowers less fair than when her reign began ?
 Does prodigal Autumn to our age deny
 The plenty that once swell’d beneath his sober eye ?

“ Look on this beautiful world, and read the truth
 In her fair page : see, every season brings
 New change to her of everlasting youth ;
 Still the green soil with joyous living things
 Swarms ; the wide air is full of joyous wings ;
 And myriads still are happy in the sleep
 Of Ocean’s azure gulfs, and where he flings
 The restless surge. Eternal Love doth keep
 In his complacent arms the earth, the air, the deep.”

BRYANT.

The shingle beach presently becomes sand as we approach the angle of the bight, and after a few yards the shore is covered with a wilderness of rugged shapeless masses of conglomerate that have fallen from the cliff. Ledges of flat or very slightly inclined rock run out into the sea in several successive spits at this

point, just beneath the bluff headland known as Bink-leaf, (probably a local corruption of Byng Cliff or some such appellation.) The ledges are covered by the tide, but the recess of low water leaves a large surface exposed, which subsequently afforded me many a harvest of marine plants and animals. For the present, however, I satisfied myself with a cursory view ; climbing over the green and slippery boulders, at some risk of chafed shins, I walked out upon the low edge, marked the long narrow ribbon-like leaves of the *Zostera*, green and glossy, growing in beds in the pools and nooks that indent the ledges, and the purple tufts of mossy sea-weed that fringe the dark hollows of the rock ; turned over a few stones, and saw colonies of the plump and fruit-like Smooth Anemone (*Actinia mesembryanthemum*) of various hues, adhering to their sides ; essayed to catch one or two of the nimble little Blennies that shot from covert to covert in the rocky basins ; and having satisfied myself that the ground was promising, I sought for a place where I might climb the cliffs, and enjoy the widened prospect from their summit.

The inclination of the slope allows access to the top a little farther on, and I wended my way up over the rugged but turf-covered steep, through thickets of furze and bramble, thence walking back along the margin of the cliff. It was a lovely day in the beginning of April, but the northern breeze made it cold ; the clear transparent blue of the sky was speckled over with fleecy clouds, which, as they flitted along, made a constant alternation of sunshine and shadow. A noble view of the broad Bay is before one at this

COLLECTING UNDER BYNG CLIFF.



spot; the sea below, of a pale greenish-blue hue, becoming more silvery as it merges into distance, and the reflection grows more perfect; the undulating outline of the land to the north, with those smoothly rounded swellings and sinkings that are so characteristic of the chalk formation; and now and then the broad white cliffs; Portland to the south, with its long breakwater, and its busy works on shore, from which some tin-covered roof happened at the moment to reflect the rays of the sun above direct to my eye, as if it had been a mirror; and beyond its precipices there was the sea again over the Chesil beach. The steamer "Contractor,"—gaudily painted in green and white, that plies between Weymouth and Portland, whose unpoetical name the good people here pronounce with a strongly-marked accent on the first syllable,—was running across the Bay, almost as if under my feet; and far away in the Channel some ocean steamer, of gigantic dimensions, was making her way upward, with a long line of black smoke streaming away behind her, half way across the horizon.

The birds and insects were enjoying the spring sunshine. A dozen larks were scattered about the sky, and humbler songsters were chirping among the brambles. A few wild bees were humming over the turf, which glittered with the yellow pilewort and bright-eyed daisy, but afforded as yet few of those flowers that bees delight in. Among the grass at the very verge of the precipice, as I sat there a moment to survey the shore below, I found that curious beetle *Meloe proscarabaeus*, a rather large insect of a deep dull indigo tint, easily recognisable, should you ever

fall in with it, by its very short wing-cases, which do not half cover its enormous distended body. I took it up gently in my fingers, when it helplessly crumpled up its legs, as if it had learned the lesson divinely taught, but which Christians find it so hard to practise—"Resist not evil,"—and lay passively in my hand, weeping at every joint of every limb a tear of orange-coloured fluid, that has conferred the name of Oil-beetle upon it. This liquor, which had a rank odour, stained the skin of my hand; and I soon put down my captive, who was glad to disappear among the stalks of the grass.

Swimming in the sea not far from the shore, I saw a bird that was evidently larger than a goose; with the aid of a pocket telescope I made out that it was a Loon, or Great Northern Diver (*Colymbus glacialis*), a very fine sea-fowl, and not uncommon on the Dorset coast in winter. The rocky beach below was destitute of anything that could alarm the wary bird, and he gradually swam in nearer and nearer, till at length he was not a stone's throw from the shore; and I, from my lofty lookout, had a fair view of him, now swimming leisurely, turning hither and thither, now diving with grace, disappearing with rapidity, and coming up after many seconds, a long distance from the spot.

A fisherman passing by told me a curious circumstance connected with the tides in this Bay, which by experience I afterwards found to be correct. Instead of alternately ebbing for six hours and flowing for the same period, as usual, the tide here remains at its lowest for four hours before it begins to flow; or, as the customary expression is, there are four hours'

flood, four hours' ebb, and four hours' standing water. This peculiarity is seen with most distinctness at the time of spring-tide, but is liable to some variation from the influence of winds, &c. The water, moreover, does not lie, for four hours, exactly at the same level; since there is more or less of a secondary tide, called the Gulder, which soon after the lowest ebb rises a little, and commonly falls again (but not invariably) towards the end of the four hours of standing water. This continuance of the recess of tide is very useful to the naturalist, since it allows him to prosecute his examinations for a much longer period at once; though, as a *per contra*, the long exposure to the air being more than some animals and plants could bear, they are compelled to reside at a lower level, and hence the low-water line around Weymouth is less rich in species than on other coasts, where it is uncovered only a few minutes at each tide.

COLLECTING SEA-WEEDS.

The first point to be attended to, is the procuring of living sea-weeds, the vegetable element in the combination which is displayed in an Aquarium. And this must naturally be the first thing, whether we are stocking a permanent tank, or merely collecting specimens for temporary examination, as we cannot preserve the animals in health for a single day, except by the help of plants to re-oxygenate the exhausted water. By their means, however, nothing is easier than to have an Aquarium on almost as small a scale as we please; and any visitor to the sea-side,

though there for ever so brief a stay, may enjoy, with the least possible trouble, the amenities of zoological study in a soup-plate, or even in a tumbler. It is easy to knock off with a hammer, or even to dislodge with a strong clasp-knife, a fragment of rock on which a minute sea-weed is growing, proportioning the surface of leaf to the volume of water,—and you have an Aquarium. A wide-mouthed phial,—such, for instance, as those in which Sulphate of Quinine is commonly sold by the chymists,—affords a capital opportunity for studying the minute Zoophytes, Bryozoa, Nudibranch Mollusca, &c., as they may be examined through the clear glass sides with perfect ease, by the aid of a pocket-lens. The influence of light should be allowed to operate on the sea-weed, to promote the elaboration of oxygen; but at the same time, if the weather be warm, care must be taken that the subjects be not killed by the sun's heat.

The long tongues or ledges that run out into the sea towards the east, nearly flat, and so low as to be overflowed even at low water of neap-tides, afford me a rich harvest of *Algæ*. They are full of narrow fissures, overhung by the tangled Bladder-weed, under the shadow of which flourish whole hosts of delicate plants, olive and green, pink, crimson, and purple, which to behold is to admire. I shall have occasion hereafter to speak of these in detail, and of the modes of collecting them for the Aquarium, and shall therefore for the present dismiss them.

These tangled masses of olive Bladder-weed, that sprawl, like dishevelled locks, slovenly and slippery, over acres of the low-lying ledges, are studded all

over with those little smooth globose shells that children delight to gather, attracted by the variety and gaiety of their hues—brown, black, orange, yellow, often banded with black, or marked with minute chequers. This most abundant little Winkle, for it is one of that genus (*Littorina littoralis*), feeds on the Fucus, like the unowned cattle on the American Pampas, and it must be owned that a spacious and fertile pasture-ground is allotted to it.

Among these we see, less numerous, but sufficiently common, the more bulky and still more familiar form of the Periwinkle (*L. littorea*), marching soberly along beneath his massive mansion, stopping to munch the tender shoot of some Alga, or leisurely circumambulating the pretty tide-pool which he has chosen for his present residence. You may tell that all his movements are marked by gravity and deliberation ; for if he does not let the grass grow under his feet, (I beg his pardon, he has but one foot ; though, as that is somewhat of the amplest, he is not deficient in *understanding*,) he lets it grow over his head. It is quite common to see one of these Mollusks adorned with a goodly Ulva or other sea-weed that has taken root on the summit of his shell, so that he habitually sits under the shadow of his own roof-tree.

“ But why does he talk to us about such common trash as periwinkles ? ” Be not captious, gentle reader ! The Periwinkle is an humble member of society certainly, but there are one or two points about him that render him not wholly unworthy of your notice. If you have seen him only fast shut up within his stony shell, with his tight-fitting opercle or “ cap ” shut close

down, defying all intrusion into his privacy, there is nothing very attractive in his person ; but when you look at him crawling, especially through the side of a glass vessel up which he is quietly mounting, you may possibly find something to admire in his zebra-like stripes and netted markings. I have more than once heard the surprised exclamation, "Why, he is quite a handsome creature !" But "handsome is that handsome does ;" the Periwinkle is *useful*, especially to those who mean to keep an Aquarium. The sea-water constantly holds in suspension millions of the spores (or seeds) of Algæ, ready to adhere and grow as soon as they find a resting-place, and these are particularly abundant in the warm season. Whether those of the green kinds, the *Chlorosperms*—as the *Ulva*, *Enteromorpha*, and various kinds of *Confervæ*—be more plentiful than others, or whether they are more easily satisfied with a place congenial to their growth, I know not ; but these grow most obviously, in the proportion of a thousand to one. Before we have kept our tank stocked a fortnight, its transparent sides begin to be sensibly dimmed, and a green scurf is seen covering them from the bottom to the water's surface, which constantly accumulates, soon concealing the contents of the vessel from distinct observation. On examining this substance with a lens, we find it composed of myriads of tiny plants, mostly consisting of a single row of cells of a light green hue, forming minute threads which increase in length at the extremity ; others display small irregularly puckered leaves of deeper green, which develop themselves into *Ulva*, or *Enteromorphæ*.

If we design the Aquarium to be of any service to us in the observation of its contents, this growth must be got rid of, or we might as well have a vessel with opaque sides. Here then comes in the aid of the Periwink. Exclusively a vegetable-eater, he delights in the green sea-weed, and nothing can be more congenial to his palate than these tender succulent growths. The little Yellow Winkle that I first spoke of possesses a similar appetite ; but he is less suitable for the service required, inasmuch as his constitution appears unable to bear constant submersion ; his habit is to live a good deal exposed to the air, and even to the hot sun, and this seems essential to his health. I have found that if this little species be collected, pretty as the individuals are, they crawl around the sides for a day or two, as if seeking a more genial dwelling, and then one by one fall to the bottom and die. There is, however, another genus of Univalve Mollusca which may be made equally available with the Periwink, if indeed it be not superior for the purpose ; I allude to those evenly conical shells, which belong to the genus *Trochus*, sometimes called, from their form, Tops. Two species, *T. cinerarius* and *T. umbilicatus*, are scarcely less abundant on our weedy shores than the Periwinkles ; the former of a dull purplish grey, marked with close-set zigzag lines ; the latter rather flatter, usually worn at the summit, of a dull olive or green, with narrow reddish bands radiating from the centre. Both are pearly in the interior, but the latter species is brilliantly iridescent.

These Tops and the common Periwink are very useful inhabitants of a marine tank ; they make them-

selves at home, and feed readily. It is interesting to watch the business-like way in which they proceed. I have just been looking carefully at a Top doing his work, watching the *modus operandi* with a pocket-lens. At very regular intervals, the proboscis, a tube with thick fleshy walls, is rapidly turned inside out to a certain extent, until a surface is brought into contact with the glass having a silky lustre; this is the tongue; it is moved with a short sweep, and then the tubular proboscis enfolds its walls again, the tongue disappearing, and every filament of conferva being carried up into the interior from the little area which had been swept. The next instant, the foot meanwhile having made a small advance, the proboscis unfolds again, the tongue makes another sweep, and again the whole is withdrawn; and this proceeds with great regularity. I can compare the action to nothing so well as to the manner in which the tongue of an ox licks up the grass of the field, or to the action of a mower cutting down swathe after swathe as he marches along. The latter comparison is more striking for the marks of progress which each operator leaves behind him. Though the confervoid plants are swept off by the tongue of the Mollusk, it is not done so cleanly but that a mark is left where they grew; and the peculiar form and structure of the tongue, which I am about to notice, leaves a series of successive curves all along the course which the Mollusk has followed, very closely like those which mark the individual swathes cut by the mower in his course through the field.

The tongue, by which this operation is performed,

is exquisitely constructed for its work. It is indeed a wonderful instrument in the complexity of its armature. The appearance and position of the organ would surprise any one who searched for it for the first time; and as it is readily found, and as Periwinkles are no rarities, let me commend it to your examination. The easiest mode of extracting it, supposing that you are looking for *it* alone, is to slit the thick muzzle between the two tentacles, when the point of a needle will catch and draw out what looks like a slender white thread, two inches or more in length, one end of which is attached to the throat, and the other, which is free, you will see coiled in a beautiful spiral within the cavity of the stomach.

By allowing this tiny thread to stretch itself on a plate of glass, which is easily done by putting a drop of water on it first, which then may be drained off and dried, you will find that it is in reality an excessively delicate ribbon of transparent cartilaginous substance or membrane, on which are set spinous teeth of glassy texture and brilliancy. They are perfectly regular, and arranged in three rows, of which the middle ones are three-pointed, while in each of the outer rows a three-pointed tooth alternates with a larger curved one somewhat boat-like in form. All the teeth project from the surface of the tongue in hooked curves, and all point in the same direction.

The action of this sort of tongue is that of a rasp, the projecting teeth abrading the surface of the plants on which the animal feeds, just as the lion is said to act with the horny papillæ of his tongue on the flesh

of his victim. The general structure is common to all the Gasteropod Mollusca, but the varieties in the mode and pattern of the dentation are almost infinite.

The little Top, for example, has the teeth set in eleven longitudinal rows, along the central part of the ribbon ; while the edges, which are turned over on each side, are formed into oblique combs ;—altogether a very elaborate affair. But even this is exceeded by the tongue of the Livid Top (*T. ziziphinus*), a larger and handsomer species, not rare among the lower rocks. (*See Plate II.*) Here the teeth are long overarching glassy plates, finely pointed, and minutely saw-toothed along their edges, while the lateral combs are composed of curved teeth, gradually diminishing in thickness.

Perhaps every variety is accompanied by some variation in food or mode of feeding. The Periwinkle, I see, has a manner of his own, which differs slightly from that of the Trochus. When he eats, he separates two little fleshy lips, and the glistering glass-like tongue is seen, or rather the rounded extremity of a bend of it, rapidly running round like an endless band in some piece of machinery ; only that the tooth-points, as they run by, remind one rather of a watch-wheel. For an instant this appears, then the lips close again, and presently re-open, and the tongue again performs its rasping. It is wonderful to see ;—perhaps not more wonderful than any other of God's great works, never more great than when *minutely* great ;—but the action and the instrument, the perfect way in which it works, and the effectiveness with

which the vegetation is cleared away before it, all strike the mind as both wonderful and beautiful.

There are other things, however, besides Periwinkles and Tops, to be found on these cleft and weed-draped ledges. The very first hour I spent in searching them, I found several animals that were new to me, and some that are marked as rare in zoological works. Among them was an *Actinia* of much beauty, which was known hitherto only by a single specimen found here by Mr. W. Thompson, and described by him under the name of *A. clavata*. I afterwards found it quite common in these ledges, of which it appears characteristic.*

Its habit is to lurk in narrow fissures, in the cavities of the under sides of stones, or not infrequently in the deserted holes of *Pholas* or *Saxicava*. The disk is wide and flat; and as it is very expansile, it spreads itself to a considerable distance around the margin of its hole. So essential is it to its comfort, however, that it should have a retirement, that if it be put into an Aquarium, though it may at first affix itself to a flat stone or to the surface of a shell, it will crawl along upon its base till it finds some loose stone, beneath which it will insinuate itself till it is quite concealed; or a narrow crevice or fissure, as between two contiguous stones, into which it may thrust its body.

* I have since received several specimens from Torquay, where it appears rare. Mr. W. P. Cocks, in the Report of the Cornwall Polytechnic Society, for 1851, describes the same species as rare at Falmouth; he has given to it the name of *A. Balii*, but Mr. Thompson's name has the priority.—(Second Edition.)

This species, which I shall call the Weymouth Anemone, is very easily distinguished from any other that I am acquainted with, by several constant characters; and though there are three well-marked varieties, they are all easily recognised as constituting but one and the same species. The marks common to all, and yet peculiar, are the following. The exterior surface is rough with numerous sucking-glands, arranged in close-set perpendicular ridges of pale-yellow warts, with a crimson freckled skin showing between. Every wart has a crimson speck on its summit; and as these are small and numerous, they impart a general red hue to the whole body. The tentacles are not numerous, and are chiefly marginal; they are pale pellucid-yellowish in one variety, and in another lovely rose-colour, but in either condition are studded with transversely-oval specks of opaque white; these organs are usually much spread horizontally, with their tips often curled inward. Another remarkable peculiarity of this species, is the degree to which it becomes transparent, by distension with water. The effect of this is not the general swelling of the body as in *A. crassicornis*, which is remarkable for the same habit effected in another way, but the great dilatation of the disk and tentacles, which then expand to an extraordinary degree, both becoming so diaphanous as to be almost destitute of colour, and showing with absolute clearness the convoluted filaments within the septal divisions of the interior.

The third variety I have alluded to, is principally found in deep water, though I have obtained one or

two remarkably large examples of it on Byng Cliff Ledge. It is larger in size, and coarser in appearance than the other kinds, and is always tinged with a bluish-grey or livid-green hue, though the characteristic marks and habits are always to be recognised. It is fond of taking up its abode within the angular cells or chambers of *Eschara foliacea*, which affords a retreat to so many and so various creatures.

I found beneath a stone another specimen of a worm that seems to be uncommon, but which I have met with also near Ilfracombe, as I have recorded elsewhere,—the Black Sand Worm (*Arenicola branchialis*) ; and a much more elegant animal of the same class, which was new to me, *Sigalion boa* ; it bears a general resemblance to the scale-bearing *Polynoes*, but is drawn out to a much greater length, with very numerous segments. Crawling in a pool occurred also the beautiful Orange Pleurobranchus (*P. plumula*) ; the great yellow Doris (*D. tuberculata*) was adhering to a stone out of water, having resorted to the shallows, doubtless, for the depositing of its ribbon of spawn, where it had been left by the recess of the tide ;—and the pretty little Cowry (*Cypraea Europaea*), with ribbed porcelain shell, and elegantly painted body, was not uncommon. I saw for the first time *Pilumnus hirtellus*, a little hairy Crab that has a great love for the darkness, always resorting to the obscurest crannies ; and *Athanas nitescens*, a tiny species of Prawn, of a dark sea-green hue, whose well-developed pincers give it so much the aspect of a lobster, that it is generally believed, without doubting, by the fishermen, to be the young state of that much-honoured Crustacean. The

habit of this pretty little species is to congregate in some small hollow covered by the tide, usually beneath the shelter of a protecting stone ; so fond is it of companionship, that if you find one you may pretty surely calculate on more. I have taken, one by one, as many as fifteen out of a hollow hardly more than a foot square. It lives long in an Aquarium ; but you will rarely see it except you have occasion to empty the contents, when you will see your Lobster-prawns, as the last drops of water drain off, kicking and skipping about from beneath some piece of rock, where they had long been lurking unsuspected.

In the accompanying Plate, several animals and plants are depicted, which inhabit these ledges. In the foreground, near the middle of the picture, *Trochus ziziphinus* is represented crawling over a large stone. Behind it, on the mass of rock, two specimens of the Smooth Anemone (*Actinia mesembryanthemum*) are seen ; both are of the common dark crimson variety, the one being contracted, the other expanded : the latter displays its petal-like tentacles, and the curious azure tubercles that stud the margin. Around the edge of a projecting rock on the right hand is creeping *Doris pilosa*, a pretty white species of the Nudibranch Mollusca.

Behind this is a tuft of the elegant *Griffithsia setacea* ; and a much-cut frond of the delicate *Dictyota dichotoma* rises from the rear of the Anemones ; while, in the left-hand corner of the foreground, is that coarse shaggy plant, the *Cladophora arcta*.



H. S. Green, Jr.

Bennet Brown & Co.

THE SMOOTH ANEMONE &c



CHAPTER III.

Let a man have all the world can give him, he is still miserable, if he has a grovelling, unlettered, undevout mind. Let him have his gardens, his fields, his woods, his lawns, for grandeur, plenty, ornament, and gratification ; while at the same time God is not in all his thoughts. And let another man have neither field or garden; let him look only at nature with an enlightened mind—a mind which can see and adore the Creator in his works, can consider them as demonstrations of his power, his wisdom, his goodness, and his truth : this man is greater as well as happier in his poverty than the other in his riches.

JONES OF NAYLAND.

I WONDER whether others are conscious of a feeling which I continually find ; a disposition to think that that which is remote must be better than that which is near. It prevails in spite of myself; in spite of knowledge and reasoning : thus I am constantly gazing out with longing eyes on the blue cliffs of the receding coast, and saying, half unconsciously, to myself,—“I wish I were at the foot of those cliffs ; what treasures I might find there !” though reflection tells me that the spot where I am is of the very same character, and would assume the same tantalizing position were I yonder.

The majestic mass of Portland, rising out of the sea right in front of me, awakened a desire to go over and explore its shores ; and as soon as spring-tide arrived I made an opportunity to gratify my desire, though the

day was almost as unpropitious as could be, the weather being cold and rainy.

The zeal of an explorer, however, is not to be so easily quenched ; and accordingly, accompanied by a gentleman of the town, I crossed the Bay, in one of the steamers that ply daily between Weymouth and Portland.

The island has but one commodity, *stone*; and that is abundant enough. A massive quay is built of huge square blocks, whose weight and form are sufficient to ensure their stability ; at least I suppose so, for no trace of cement is visible at the joints. Similar blocks are piled on each other, all over the wharves and their approaches, so that the passengers have to thread long narrow alleys between cyclopean architecture ; thinking, as they wind along, of the Pyramids, or the ancient temples of Thebes. We walked along the shore towards the Breakwater, but it was most laborious work, and as unproductive as toilsome. The shore is formed of loose angular blocks and rolled boulders of the same freestone, over which walking is difficult and hazardous ; and rood after rood we pass, without discerning a tuft of seaweed, except of the commonest kinds, and those—as *Ulva*, *Enteromorpha*, *Cladophora*, &c.—stunted and ill-grown. Of course animals are equally scarce, except such as haunt the open sea; for no pools can exist among these shifting masses, and besides some two or three rock-loving species, as *Actinia mesembryanthemum*, and *Trochus umbilicatus* and *T. cinerarius*, we saw absolutely nothing here. The *Trochi* indeed were unusually fine ; and the former species, which is

generally found with the summit of the shell worn away so as to expose the nacre, was almost universally perfect and unworn.

A slanting ledge farther on, dipping down into the tide, and well covered with matted *Fucus*, had some narrow fissures, which we examined. In these we found the little Shanny (*Blennius pholis*), or *Tansy*, as it is called here, a fish rarely exceeding five inches in length, which delights in such restricted limits; it is remarkable for the variety of its colours, scarcely two being found alike; these are often pretty, and its brilliant scarlet eyes make it attractive. It is one of the most suitable fishes for an Aquarium, as it is readily procured, bears handling with impunity, quickly becomes reconciled to imprisonment, and will continue healthy with a far lower supply of oxygen in its water than many others could tolerate for a single day. I may have occasion to speak of this little fellow again.

As we saw no probability of finding here anything that we could not procure any day under the Nothe or Byng Cliff, we at length deserted the shore, and roamed a little way up the hill. It was near the end of April the Cowslips were shooting up their erect yellow tufts in great profusion through the short turf, and the air was loaded with their sugary fragrance. Where the ground was broken, the blue Hyacinth was also in blossom; and the two elegant flowers mingled their tall succulent pillar-like stalks in gentle rivalry: both being remarkably fine of their kind. The Spinous or Burnet Rose (*Rosa spinosissima*) was just clothing its prostrate stems with the young leaves, and giving

promise of both beauty and sweetness, when these fair flowers shall have died away; and the clusters of leaves, arranged in dense rosettes, of that caustic plant, the Spurge (*Euphorbia Portlandica*), were so numerous as to be quite characteristic of the place.

The terrestrial Mollusca made up by their profusion and variety the paucity of the marine kinds. The common Garden Snail (*Helix aspersa*) was scattered by myriads on the heaps of loose stones, and, on turning over the heaps, they were found as thickly lodged in the interior. The more beautiful Banded Snail (*H. nemoralis*) was also common and particularly large; indeed there seems something in this stony island favourable to the development of bulk in its natural history; for I observed that many of the plants and animals which it yields in common with other places had attained more than wonted size. There was the Heath Snail (*H. ericetorum*), a little species prettily banded with brown, with a large umbilicus perforating the centre of the shell nearly through and through; the Silky Snail (*H. sericea*)—at least I think it was this species—the shell slightly woolly, with a surface of short hairs; and the Stone Snail (*H. lapicida*), with a deep umbilicus, and a sharp edge or keel running round each whorl of the shell. The name of *Lapicida* or Stone-cutter, which Linnaeus conferred on this pretty Snail, refers to no peculiarity of habit that I am aware of, except that of frequenting stony places; though, to be sure, there is no other trade so suitable to an inhabitant of Portland as this of stone hewing, which engages the attention of nine-

tenths of its human occupants. We found it snugly lodged in small cavities on the under sides of the loose-lying stones, which, however, it was assuredly innocent of having excavated. One more: the elegant Cyclostome (*Cyclostoma elegans*) was likewise numerous, perhaps the most interesting of all. The late warm rains had drawn it from its winter-quarters, and it was now crawling by scores over the twigs and leaves, with its spiral shelly operculum carried behind. The mode in which this pretty mollusk proceeds is very curious: for the under-surface of the foot, which is long, is divided by a deep fissure into two parallel ribbons, which take hold of the twig alternately, one portion making good its hold while the other is advanced in turn.

But the rain at length began to come down in earnest, and as our scientific zeal had been but poorly supported by success, it gave in; and, succumbing to the storm, we retreated to the cabin of the steamer, which soon disgorged us dripping on Weymouth Quay.

THE BROAD-CLAW.

A very learned zoologist and very charming writer, for whose writings I entertain the highest respect, says:—"It is folly and vanity to attempt to account for all facts in nature, or to pretend to say why the Great Creator made this thing, and why He made that, and to discover in every creature a reason for its peculiar organization. It is but another form of the same vanity, having satisfied itself of the discoveries it has made, to pretend to praise the All-wise Maker's wisdom in so organizing his creatures. That God is

all-wise is a revealed truth ; and whether the organization before us seem excellent or imperfect, it matters not ;—we *know* it is perfect and good, being the work of an all-wise God.''*

To this last sentiment I cordially subscribe ; but I am not sure whether the former assertions are not a little too sweeping ; or perhaps somewhat too incautiously expressed. It is consummate folly and vanity, indeed, to assume that *we have accounted* for all facts in nature, and for the reasons of them ; but not (as I think) reverently and humbly to *seek after* the reasons of those phenomena which at present are recondite. Doubtless, in the present limited and lapsed condition of our faculties, at least, there will ever remain profundities in the physical creation, unfathomable by any sounding-line we can cast into them ; but the conviction of this truth needs not prevent our penetrating as deep as we may, and recording those observations, which, if carefully made, will not fail to reward us with increased knowledge of His works and ways, “ Whose way is in the sea, and his path in the deep waters, and whose footsteps are not known.” There is always something to learn in studying the works of God, as there must always remain *an infinite unknown*.

And is the ascription of praise to God for what we dimly discover of excellence in His handiwork,—vanity? Surely not ; for the Holy Scriptures direct us to this work ; Jehovah himself vouchsafing to declare, “ He that offereth praise glorifieth Me ;” and

* Forbes's British Star-fishes, p. 98.

many parts of His word, such as the Psalms of David, the Proverbs of Solomon, the Book of Job, and the teachings of the Lord Jesus himself, instruct us how to do this, and furnish us with examples, in the various details of the habits, instincts, and economy of what we call the works of Nature. It is given as the solemn condemnation of the polished nations of antiquity, that "when they knew God [viz. in the works of His creation] they glorified Him not as God" (Rom. i. 21). It was not that men were lacking among them who, as now, in their measure, studied and admired the works of Nature, so called, *but no praise, no glory, accrued to God* from their studies.

There is found in the crannies and clefts of the rocky ledges, and beneath stones that lie at the verge of low water, a little Crab of somewhat peculiar structure and no less interesting habits, which affords me the text for my discourse above written. It is the Hairy Broad-claw (*Porcellana platycheles*), one of those interesting species that connect groups differing very widely from each other in their typical forms. The Common Crab and the Lobster appear very remote from each other in their obvious characters, but these Porcelain Crabs occupy a "debatable ground" between them. Any one on looking at one would say in a moment, It is a Crab; its broad, flat carapace is unmistakeable, and the thin abdomen or tail is carried just as the Common Crab carries his, pressed close up to the under-side of the chest. But when we come to examine it closely, we find the last joint of this very abdomen furnished with fringed swimming-plates, like that of a Lobster, the foot-jaws are largely deve-

loped, and the antennæ are much longer than the body; while in general conformation and structure it bears the closest affinity with another Crustacean, found commonly in the same haunts, which, from the form of the carapace and the free abdomen, every one would immediately pronounce to be a Lobster; and it is so named by the common people. I refer to the little "Dutch Lobster" (*Galathea squamifera*).

Let us now look at the manner of life of the little Crab, and we shall discover some interesting relations between its habits and its conformation. I have said that it inhabits crevices, and the under-sides of stones. As soon as it is dropped into the Aquarium, it throws out its abdomen, or "tail;" and gives several smart flaps with it, which shoot it along diagonally backwards, as if to say, "Though I am a Crab, you see I have learned to behave myself in some things like my courtly cousins, the Lobster family." But he is not much of a swimmer; the flaps merely bring him to the bottom slantwise, instead of perpendicularly, whence he does not rise again. You turn your head away, and, on looking again, you cannot think what is become of your Broad-claw! I have put in half-a-dozen at a time, and have been astonished that, in a few moments, not one was to be seen; till, perhaps weeks afterwards, on cleaning out the tank, I have found every one clinging fast to the under-side of some piece of stone that lay on the bottom. When I knew this, I placed flattish stones so close to the glass sides that I could look beneath them, and had the pleasure of finding them occupied by the Broad-claws. The crevice formed by the inclination of the stone to the

bottom may be very narrow, and I am not sure but that the Crab likes it all the better, for he is expressly formed for such a dwelling; his body is particularly flat, his legs move in the same plane, and his claws, though large for his size, are remarkably flat also, thinned out, as it were, to an edge; so that the whole animal has somewhat the appearance of having been crushed flat by the pressure of the stone under which he lives. Here, then, is a beautiful adaptation of structure to habit; but there is more of the same kind. The Crabs are carnivorous, and in general they are very active, wandering continually in search of prey, which they seize, when observed, with their claws. How is our little Broad-claw to live, clinging fast to his cranny, which he forsakes not from one month's end to another? Like the thrifty housewives of London, who do not go to market, but have their bread and meat and groceries brought to their door. Let us see how this is managed. Professor Bell, in his beautiful "History of British Crustacea," thus alludes to one character of this genus. "External pedipalps greatly developed; the second joint very large, rounded, with a single tooth on the outer anterior angle; the third joint much smaller, irregularly trigonal, and with the remaining joints fringed with long hair at the edges." In fact, however, *all* these joints are fringed with hair, which curves inwards, but its use in the economy of the animal has not yet, so far as I am aware, been made known.

Watching a Broad-claw beneath a stone close to the side of my tank, I noticed that his long antennæ were continually flirted about; these are doubtless

sensitive organs of touch, or some analogous sense, which inform the animal of the presence, and perhaps of the nature, of objects within reach. At the same time I remarked that the outer foot-jaws (*pedipalps*) were employed alternately in making casts, being thrown out deliberately, but without intermission, and drawn in, exactly in the manner of the fringed hand of a Barnacle, of which both the organ and the action strongly reminded me. I looked at this more closely with the aid of a lens: each foot-jaw formed a perfect *spoon* of hairs, which at every cast expanded, and partly closed. That you may understand this better, I must say that the foot-jaw resembles a sickle in form, being composed of five joints, of which the last four are curved like the blade of that implement. Each of these joints is set along its inner edge with a row of parallel bristles, of which those of the last joint arch out in a semicircle, continuing the curve of the limb; the rest of the bristles are curved parallel or concentrical with these, but diminish in length as they recede downwards. It will be seen, therefore, that when the joints of the foot-jaw are thrown out, approaching to a straight line, the curved hairs are made to diverge; but as the cast is made, they resume their parallelism, and sweep in, as with a net, the atoms of the embraced water.

The microscope revealed to me a still higher perfection in this admirable contrivance. I then saw that *every individual bristle* is set on each side with a row of short stiff hairs, projecting nearly at right angles to its length; these hairs meeting point to point those of the next bristle, and so on in succes-



FOOT-JAW OF BROAD-CLAW.

sion, there is formed a most complete net of regular meshes, which must enclose and capture every tiny insect or animalcule that floats within its range; while, at each out-cast, it *opens at every mesh*, and allows all refuse to be washed away or fall to the ground. For we are not to suppose that the captures thus promiscuously made are as indiscriminately swallowed. A multitude of atoms are gathered which would be quite unfit for food, and a power of selection resides in the mouth, whether it be the sense of taste, of touch, or any other analogous but recondite perception, by which the useful only is admitted; the worthless, or at least the injurious, being rejected.

This arrangement,—which is very common in the lowest forms of animal life, where food is brought by constant ciliary currents,—reminds me of the Gospel net, mentioned by our Lord, which is “cast into the sea, and gathers of every kind; which, when it is full, they draw to shore, and sit down, and gather the good into vessels, but cast the bad away” (Matt. xiii. 47, 48). Persons of all sorts are gathered into the professing Church here on earth; it is an indiscriminate collection that determines nothing as to the eternal condition of those who are embraced by it: the selection is to be made “at the end of the age,” when it will be found that not every one that saith “Lord, Lord! shall enter into the kingdom of heaven.” O reader! see to it that you are robed in the righteousness of Christ, that “wedding garment,” without which the Christian name and profession will bring only the deeper condemnation!

I am afraid the many words I have been compelled

to use in describing this structure and its operation, may not convey to my readers the same strong impression of fitness and perfectness of contrivance, which a glance at the little Crab, when at work, would give ; to myself, it appeared one of the most striking examples I had ever seen of that compensatory adaptation of an organ to a requirement, which Paley has so well illustrated. Perhaps I ought to add, that in order to see the structure of the bristles, they must be examined when recent, or preserved in fluid ; for, in drying, the hairs fall down and adhere to the side, so as to be undistinguishable.

But I have not yet done with my little eremite. I the less reluctantly linger on the contrivances displayed in his economy, because he is so common, and so readily procured, that any of my readers who may visit a rocky shore at low water, may verify these particulars for themselves. When you first take up one in your fingers, (which, by the way, do with a little caution, for these gentlemen nip pretty hard,) one of the most obvious peculiarities is that, besides these flat nippers, you can find only three pairs of legs instead of four, the complement which Crabs in general rejoice in. You may institute a minute examination, as I did with the first individual that I met with, and yet fail to discover any more ; but there is, notwithstanding, a fourth pair,—very minute indeed, tiny slender pins, set a little above the general level, and folded down so closely in a groove, beneath the edges of the carapace, as to be almost invisible.

What is the use of these feeble limbs ? No one that I asked could tell me ; till I asked the Crab

himself, or rather looked on while he used them. Strange to say, they are didactyle, each being terminated by a minute hand or claw of two fingers. They are set, moreover, with radiating hairs, so that in all respects they are the very representatives of the anterior feet of the Prawn, which I shall presently have occasion to describe, though placed at the opposite end of the series. And this resemblance is not one of structure only, *but of function also*; for these feeble limbs are the *cleansing brushes*, with which the Broad-claw washes his person, applying them, with the greatest ease, *to the whole surface of the abdomen, and inferior region of the carapace*, while the fingers of the little hand are used to pick off adhering matters, that cannot be removed by brushing.

I do not then consider it an useless exercise to seek for the reasons of any organization that seems unusual or abnormal. When once these members that I have been speaking of are seen in natural action, their purposes become evident, and the perfection of their contrivance becomes admirable; and we may use them as a fresh occasion of ascribing honour to the Infinitely Holy, Wise and Good God, all whose works praise Him.

“Each shell, each crawling insect holds a rank
Important in the plan of Him, who framed
This scale of beings; holds a rank, which lost,
Would break the chain, and leave behind a gap
Which nature’s self would rue.”

STILLINGFLEET.

A DREDGING DAY.

The morning was clear, and promised a fair day ; there was breeze enough to enable a boat to work—enough, in fact, to raise what sailors call a “cat’s paw” upon the surface of the sea, and not sufficient to cover it with “white horses.” It was a nice time for a dredging excursion, though rather cold ; and I sent word to Jonah Fowler to bring his boat over, and we would try a haul. The sun came out while we were waiting, and penetrated through the clear water to the bottom ; and the reflection of his rays from the dimpling surface threw up on the boat’s quarter a running pattern of reticulate lines of light, as if to give me in that bright net a good omen of success. Little urchins stood on the quay-edge, watching the preparations with curiosity, whose hanging ringlets, and free attitudes as they stood with hands in the pockets of their loose trowsers, looked like copies (*tableaux vivants*, if you will) of the well-known print of our nautical little Prince of Wales. The trim boat’s crew of the revenue cutter were lying at the steps, or lounging with folded arms on the quay, waiting for their officer ; but it was far beneath their dignity to manifest curiosity or interest in any such matters.

The preparations are made ; the dredges and keer-drag are overhauled ; a goodly array of pans, tubs, jars, and bottles are put on board ; my mackintosh and swimming-belt are on (for you can never tell what eventualities of weather or accident may occur) ; and a stout packet of sea-stores are snugly thrust into the

locker. "Shove her off! Up with mainsail and jib!
and away to go!"

Pleasant it is to start on such an excursion. The day all before us; hope dominant; fancy busy with what treasures of the deep the dredge may pour at our feet; the sun's rays cheerful; the breeze exhilarating; a good, stiff boat, clean and light, under foot, and an agreeable companion, for such is our friend Jone;—and thus we swiftly glide out into the Bay.

"The ship was cheer'd, the harbour clear'd;
Merrily did we drop;
Below the Kirk, below the hill,
Below the light-house top."

To many of my readers probably the whole scheme now engaged in is as patent and clear as daylight; they have been out dredging themselves, and can fancy the matter perfectly, perhaps with a momentary wish that they had been

"—— there to see."

But some may honour these pages with their perusal to whom it may not yet be quite clear, what is the object of the excursion, and what the manner. While then we are running down before this north-west breeze to reach our field of operations, which is some four or five miles away, I will occupy the time with a word or two about dredging.

Valuable as are the acquisitions which the naturalist frequently makes by searching the shores at low water and at spring-tides, he feels that this gives him but a small acquaintance with the treasures held in the

possession of the mighty sea. The greater the recess of the tide, the more curious, varied, and abundant are the creatures he discovers ;—if then any mode could be devised to scrape the floor of the sea itself at different depths, and to secure the materials thus collected, how important might be the result. The dredge is the implement that does this. It is a strong bag with an iron frame around the mouth, which is dragged over the sea-bottom by a rope fastened to the boat, by which also it is drawn up when full.

The rudest form of the instrument is that used for procuring oysters for market. The bag is generally made of iron rings linked together, and the mouth, which is a four-sided frame of iron, has one of the longer sides turned out to form a scraping lip. But the naturalist's dredge is an improvement upon this form ; the oyster-dredge, with all the care employed in heaving, will frequently turn over in sinking, so that the unclipped side of the frame is on the ground, which will not scrape. Hence we have each of the two long sides of the mouth made into a scraping lip, so that the instrument cannot fall wrong. Instead of rings our body is made of spunyarn (a sort of small rope), or fishing-line, netted with a small mesh, or, which is better still, of a raw hide, (such as those which the tobacconists receive from South America enclosing tobacco, the hides of the wild cattle of the Pampas,) cut into thongs, and netted in like manner. Sometimes the bag is made of coarse sackcloth, or of canvas ; but the former soon wears out, and the latter is not sufficiently pervious to water ;—an important point ; for if there be not a free current through

the bag, while on the bottom, it embraces nothing, merely driving everything before it, and coming up empty. The hide net is almost indestructible.

To the two ends, or short sides of the frame, which forms an oblong square, are attached by a hinge two long triangles, which, meeting in front at some distance from the mouth, are connected by a swivel-joint. To this the dragging rope is bent, which must be long enough to allow thrice as much at least to be over-board as the perpendicular depth would require :—if you are dredging in ten fathoms, you must use at least thirty fathoms of line, or your dredge will make long jumps over the ground instead of steadily raking it. The inward end of the rope having been made fast to one of the thwarts, the dredge is hove to windward, and the boat is put before the wind, or at least allowed a flowing sheet.

The keer-drag is in principle similar to the dredge ; but there are peculiarities in its construction, and it is employed for different game. It is considerably larger ; the one which I used was six feet wide, and one foot high at the mouth, whereas the width of the dredge does not usually exceed two feet. The mouth consists of a stout iron rod bent up to form three sides of the quadrangle, neither of which is thinned to a lip ; the fourth side is made by a stout beam to which the iron ends are riveted, and this by its lightness is always uppermost when on the bottom. The handle is made by three lines, one of which proceeds from the middle of the beam and one from each of the two iron ends ; they are united at some ten feet from the mouth, where the drag-rope is attached. The net affixed to

this framework is made of stout twine, and diminishes in its diameter regularly like a funnel; the point, which may be about twelve feet from the mouth, is left open, as it is lashed round with a piece of line when in use. The chief peculiarity is, that the knitting is so managed that the size of the meshes diminishes evenly, as well as the diameter of the net, till at the point they are very small and close. The reason of this will be seen presently.

The Roman poet admonishes us that different localities produce different prey, and require different implements :—

“Nec tamen in medias pelagi te pergere sedes
 Admoneam, vastique maris tentare profundum.
 Inter utrumque loci melius moderabere funem.
 Aspera num saxis loca sint; nam talia lentoſ
 Deposcunt calamos; at purum retia littus.
 Num mons horrentes demittat celsior umbras
 In mare. Nam varie quidam fugiuntque petuntque.
 Nam vada subnatis imo viridentur ab herbis.

Objectetque moras, et molli serviat algæ.”

OVID. HALIEUT. 83—92.

Which may be thus freely “done into English:”—

When you the dredge would use, go not away
 Far out to sea. Mind that your haul be made
 According to your bottom. Where the ground
 Is foul and ledgy, be content to fish
 With hook and line. But where upon the sea
 The morning sun casts shadows deep and long
 From lofty Whitenose,—over with your dredge.
 Where 'neath your keel the verdant sea-grass waves,
 [The keer-drag try for nudibranchs and wrasse.
 Should all these prove distasteful, on the shore]
 For spring-tide patient wait, and overhaul the weeds.

Before we ran down to our dredging ground, my

master of the ceremonies proposed, in accordance with this good counsel, that we should haul up a point or two, and have a scrape on the *Zostera* beds that cover many acres of shallow water in the bight off Preston Valley. But let me introduce my man to you.—A clever fellow is Jone, and though only bred as a fisherman, he is quite an amateur naturalist. There is nobody else in Weymouth harbour that knows anything about dredging (I have it from his own lips, so you may rely on it); but *he* is familiar with the feel of almost every yard of bottom from Whitenose to Church-Hope, and from Saint Aldhelm's Head to the Bill. He follows dredging with all the zest of a savant; and it really does one's heart good to hear how he pours you forth the crackjaw, the sesquipedalian nomenclature. "Now, Sir, if you do want a *Gastrochæna*, I can just put down your dredge upon a lot of 'em; we'll bring up three and four in a stone." "I'm in hopes we shall have a good *Cribella* or two off this bank, if we don't get choked up with them 'ere *Ophiocomas*." He tells me in confidence that he has been sore puzzled to find a name for his boat, but he has at length determined to appellate her "*The Turritella*," "just to astonish the fishermen, you know, Sir,"—with an accompanying wink and chuckle, and a patronising nudge in my ribs. Jone is a proud man when he gets a real savant alone in his boat; and he talks with delight of the feats he has achieved in the dredging line for Mr. Bowerbank, Mr. Hanley, and Professor Forbes. I will say, I found him no vain boaster, but able to perform his professions; and can heartily recommend him to any brother naturalist who

may desire to "dredge the deep sea under," in Weymouth Bay, as one who knows what is worth getting, and where to get it.

Well, here we are in the bight, just off the mouth of Preston Valley, the only bit of pretty scenery anywhere near. This, however, is a little gem; a verdant dell opening to the sea, through which a streamlet runs, with the sides and bottom covered with woods, a rare feature in this neighbourhood. We are over the *Zostera*; the beds of dark-green grass are waving in the heave of the swell, and we can make out the long and narrow blades by closely looking down beneath the shadow of the boat. Here, then, is the place for the keer-drag. Down it goes, and sinks into the long grass, while we slowly drag it for a couple of hundred yards or so.

When disposed to try our luck we hauled on the rope, till we brought the mouth of the drag to the top of the water; a turn or hitch was then taken round a belaying pin with the two side-lines of the bridle, and the point of the net only was then hauled on board, put into a pan of water, and untied. Here was congregated the chief part of the prey taken, and hence the need of having the meshes so small in this part. Out swam in a moment a good many little fishes that haunt the grass-bed; as Pipe-fishes (*Syngnathus*) of several species, Gobies (*Gobius unipunctatus*, *G. Ruthensparri*, &c.), and bright-hued Conners (*Labrus* and *Crenilabrus*). With these were two or three active and charming Cuttles (*Sepiola*); and clinging to the meshes of the net in various parts, were several species of Nudibranch Mollusca, creatures

of remarkable elegance and beauty. All these demand more consideration than I can now stay to give them; so that I propose to return to them in detail presently, describing them to you, not from the hurried glances we can give them in the boat, but as they appear when at home in the Aquarium.

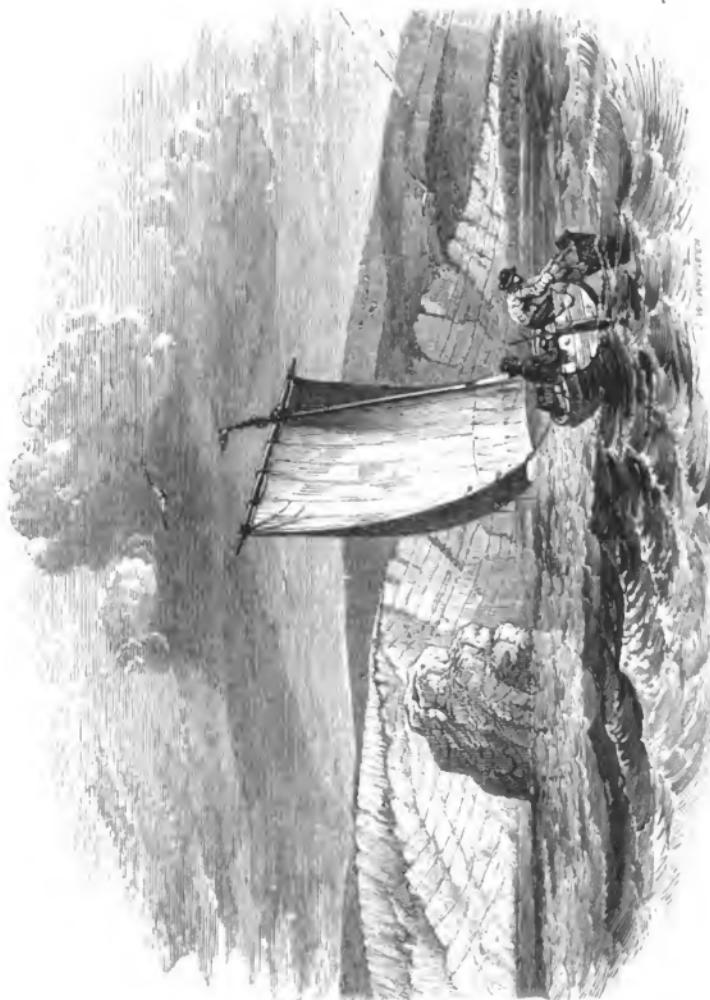
Meanwhile we put the boat before the wind and run along the inhospitable coast on our left. We leave the pleasant vale behind, and skim swiftly by the black rocks of Ratcliff Head, and the distorted and confused strata of Goggin's Barrow. We pass Osmington Mills, where a rather ample sheet of water is poured in a foaming cascade over the low cliff, and where those curious circular blocks of grit-stone, flat on one side and conical on the other, are imbedded with regularity in the sandy face of the precipice; and leave on our quarter the rocks, where the abundance of iron pyrites and sulphur has more than once presented the strange phenomenon of spontaneous fire,—a phenomenon distinctly remembered still by the inhabitants of Weymouth, who night after night used to gaze out with wonder on the Burning Cliffs.*

* In 1816, a large conical mass of earth began to slide from its base, and continued with intermissions to descend for three years, when it reached its present situation on the sea-beach, an oval cone of 800 feet in length, and about 80 in height. After a few years, smoke and steam began to issue from several cracks and apertures, about half way up its sides; and in March, 1827, fire was seen to proceed from them, on several occasions. An attempt to bore near the heated part was made, which did not succeed, in consequence of the hardness of the rock. But in April an excavation was commenced on the south side of the cliff about forty feet above the beach, the materials removed consisting of lime and alum stone, intermixed with dark bituminous earth, which was smoking at the time of removal. Stone

At length we are under Whitenose, that bold chalk cliff that is so prominent an object as the eye roves along the coast-line from Weymouth. Here we turn the boat's head to the southward, and throw the dredge overboard in fourteen fathoms. And while I am enjoying, with the line in my hand, what a dredger particularly likes to feel,—the vibration produced by the instrument as it rumbles and scrapes over a moderately rough bottom, telling that it is doing its work well,—we will gaze with admiration on this magnificent precipice of dazzling white that rears its noble head behind us. It is the termination of that range of chalk hills which, with some few interruptions, intersects the kingdom from the Yorkshire coast to Dorset; and stands in simple majesty, the snowy whiteness of its vast face unvaried, except by the slanting lines which mark the dipping-strata running across it, and which look so fine and so regular as if they had been drawn by the pen of a geometrician. My companion told me a story of a lad of thirteen, who four years ago fell from the loftiest part of the summit, 500 feet above the sea. It is true a great part of this descent was performed by rolling and sliding, but for fifty feet the fall was absolutely per-

and stone-coal were afterwards quarried out, which emitted sparks of fire sufficient for the men to light their pipes, and several gentlemen present to light their cigars. As the excavation proceeded, the fire increased to a blaze at the top, bottom, and sides; and for the last four feet the work was continued amidst red-hot materials, which ultimately compelled the men to desist. The fire from the mass thus removed was discernible from the Esplanade at Weymouth to a great concourse of persons, and the scene of this curious phenomenon still continues to present great attractions to visitors.

DREDGING OFF WHITENOSE.



pendicular. The boy had been seeking rabbits, which are very numerous on the downs above, when he fell over. Thirteen hours he lay helpless at the bottom, in the hardest frost of the winter of 1849-50, and was then found with a broken arm and thigh, but with no other important injuries.

But up with the dredge ; let us see our success. It feels pretty heavy as it mounts, and here as it breaks the surface we can already see some bright-hued and active creatures in its capacious bag. A wide board resting on two thwarts serves for a table, and on this—a few of the more delicate things, that appear at a glance, having been first taken out—the whole contents are poured. The empty dredge is returned to the deep for another haul, while we set eagerly to work with fingers and eyes on the heap before us.

What a pleasure it is to examine a tolerably prolific dredge-haul ! I am not going to enumerate all the things that we found ; it would make a pretty long list. Numbers of rough stones and of old worm-eaten shells, half of a broken bottle, and other strange matters were there ; every one, however rude, worthy of close examination, because studded with elegant zoophytes, the tubes of *Serpulae* and other *Annelida*, bright-coloured pellucid Ascidians, graceful Nudibranch Mollusca, the spawn of fishes, and endless other things. Brittle-stars, by scores, were twining their long spiny arms, like lizards' tails, among the tangled mass ; arrayed in the most varied and most gorgeous hues, of all varieties of kaleidoscopic patterns (*see Plate IV.*) ; and Sand-stars not a few. The latter are much more delicate in constitution than the former, being

very difficult to keep alive ; and also much more brittle : the former, notwithstanding their English name, I have not found so particularly fragile. Among other members of this wonderful class of animals, we obtained, in the course of our day's work, several of that fine but common one, the Twelve-rayed Sun-star (*Solaster papposa*)—a showy creature dressed in rich scarlet livery, some eight inches in diameter. Two or three of a species usually counted rare also occurred, the Bird's-foot (*Palmipes membranaceus*) ; more curious and equally beautiful. (See Plate III.) It resembles a pentagonal piece of thin leather, with the angles a little produced and regularly pointed. The central part of this disk is scarlet, and a double line of scarlet proceeds from this to each angle, while the whole is margined by a narrow band of the same gorgeous hue. The remainder of the surface is of a pale yellow or cream-colour, and covered in the most elegant manner with tufts of minute spines arranged in lines, which cross each other, lozenge-fashion, near the middle of the disk, and run parallel to each other, at right angles to the margin, between the points.

Not less attractive was another Starfish, the Eyed Cribella (*Cribella oculata*). It consists of five finger-like rays, tapering to a blunt point, and cleft nearly to the centre ; the consistence stiffly fleshy, or almost cartilaginous. The hue of both disk and rays, on the superior surface, is a fine rosy purple. (See Plate III.)

All these are very attractive occupants of an Aquarium. They are active and restless, though slow in movement, continually crawling about the rocks and

round the sides of the tank, by a gliding motion produced by the attachment and shifting of hundreds of sucker-feet, which are protruded at will, through minute pores in the calcareous integument. Their showy colours are exhibited to advantage on the dark rocks, around the projections and angles of which they wind their flexible bodies, now and then turning back a ray, from which the pellucid suckers are seen stretching and sprawling ; and as they mount the glass, not only can their hues be admired, but the exquisite structure of their spines, and the mechanism of their suckers, can be studied at leisure.

Every haul of the dredge brought up several univalve shells, tenanted, not by their original constructors and proprietors, but by that busy intruder the Soldier-crab (*Pagurus*). Several species of this curious creature occurred, to whose vagaries I may devote a chapter presently. For a similar reason I shall only just allude to the beautiful Cloak Anemone (*Adamsia palliata*), and several other species of this charming family. Long-legged Spider-crabs of the genera *Stenorhynchus*, *Inachus*, &c. were abundant, sprawling their slender limbs, like bristles, to an unconscionable distance ; tempting us to think that, if we had legs like these, we might cover the ground in a style that would put to shame the old giant-slayer's seven league boots.

But, as I have said, time and space would fail me if I were to attempt an enumeration of all the objects of interest that we brought to view in the course of a good day's dredging. Mollusca, both naked and shelled, both univalve and bivalve ; crabs, prawns,

and shrimps ; worms ; sponges ; sea-weeds ; all presented claims to notice ; and all contributed representatives to my stock, in the successive emptyings of the dredge, for we worked pretty nearly all the way home. And when we came to bring on shore the bottles, jars, pans, pails, and tubs, we found them all well tenanted with strange creatures, the greater part of which were despatched on their way to London by that same evening's mail-train.

The Plate on the opposite page represents a group from the interior of an Aquarium. Over the stone in front is crawling the Eyed Cribella (*Cribella oculata*), while a specimen of the Bird's-foot Starfish (*Palminipes membranaceus*) is mounting up the mass of broken rock behind. On the right of the picture is a small frond of the much folded and crumpled Sea-lettuce (*Ulva latissima*) ; the pencilled plant of a darker green that rises in the rear of the *Ulva* is *Cladophora rupestris* ; while a tuft of *Polysiphonia urceolata* springs from a crevice in the rock above the Star-fishes. Almost all the species have been already described in these pages.

THE SEPIOLE.

My notions of the Cephalopoda, derived from figures of the various species in books, were anything but agreeable. I thought of them as hideous, repulsive, fierce, atrocious creatures, hated and feared whenever seen. But an acquaintance with the pretty *Sepiola vulgaris* has not a little modified these ideas ; and its beauty, sprightliness, and curious habits have made it quite a favourite pet among the denizens of



E. H. Massé, Del.

Hannart, Chromo.

STAR FISHES.



my Aquarium. I take it in considerable numbers in this Bay, by means of the keer-drag already described, which rakes the bottom. It is a little creature, rarely exceeding an inch in length ; though the extensibility of the arms somewhat varies its dimensions.

When we turn out two or three from the net into a pail of sea-water, they are at first restless and active. They shoot hither and thither, as if by a direct effort of will, but in reality by the impulse of rapid and forcible jets of water, directed towards various points, from the mouth of the flexible funnel situated beneath the body. After a few moments they suspend themselves in mid-water, hovering for many seconds in the same spot, scarcely moving a hair's breadth either way, but waving their large circular swimming-fins rapidly and regularly up and down, just like the wings of an insect. Indeed, the resemblance of the little Cephalopod, in these circumstances, to a brown moth hovering over a flower, is most close and striking, and cannot fail to suggest an interesting comparison. The body is held in a horizontal position, the large protuberant eyes gazing on either side ; and the arms, grouped together in a thick bundle, hang freely downwards. If you essay to count these organs, you find only eight ; and even if you are aware that one of the characters of the genus is to have ten, of which two are much longer than the rest, you may search for these latter a long time in vain. Of course I mean during the life and health of the animal, when its impatience of being handled presents obstacles to a very accurate investigation ; you may then turn it over and over with a stick, and look at

the bundle of arms from above and below in turn, now grouped together, and now thrown all abroad in anger at being teased ; still you can make out but eight. It was not until after many trials that I at length caught a peep at the missing organs—the pair of long arms,—and discovered that it is the animal's habit to carry them closely coiled up into little balls, and packed down upon the mouth at the bottom of the oral cavity. If we manage to insert the point of a pin in the coil, and stretch out the spiral filament, the little creature impatiently snatches it away, and in a twinkling rolls it up again. A zealous votary of the circular system would seize on this analogy with the spirally folded tongue of a moth, and triumphantly adduce it as additional proof that the Cephalopoda represent, in the Molluscan circle, the Lepidoptera among insects.

While thus hovering motionless in the water, the Sepiola presents a fair opportunity for observing its curious transitions of colour, which are great and sudden. We can scarcely assign any hue proper to it. Now it is nearly white, or pellucid, with a faint band of brown specks along the back, through which the internal viscera glisten like silver. In an instant the specks become spots, that come and go, and change their dimensions and their forms, and appear and disappear momentarily. The whole body,—arms, fins, and all,—the parts which before appeared free, display the spots, which, when looked at attentively, are seen to play about it in the most singular manner, having the appearance of a coloured fluid, injected with constantly varying force into cavities in the

substance of the skin, of ever-changing dimensions. Now the spots become rings, like the markings of a panther's skin; and, as the little creature moves slightly, either side beneath the fin is seen to glow with metallic lustre, like that of gold-leaf seen through horn. Again, the rings unite and coalesce, and form a beautiful netted pattern of brown, which colour increasing, leaves the interspaces a series of white spots on the rich dark ground. These and other phases are every instant interchanging, and passing suddenly and momentarily into each other with the utmost regularity. But here is a change! One is hovering in quiescence, his colour pale, almost white; one of his fellows shoots along just over him; with the quickness of thought, the alarmed creature turns from white to an uniform deep brown, the rich full colour suffusing the skin in a second, like a blush on a young maiden's face. The hue is very beautiful; it is the fine, deep sienna-tint of tortoise-shell; a substance which, indeed, the mingling clouds of brown and pellucid horn closely resemble in the intermediate phases of colour.

- Hitherto we have seen the Sepiola only in the pail of water into which it was turned out of the net. After a little while it drops upon the bottom, and, crouching up, remains motionless; if you rouse it, it will again swim for a few moments, but presently seeks some corner, into which it thrusts its rear, and huddles up as before. This is all that you will see of its habits under such circumstances; for in all probability the morning will reveal your little *protégé* a lump of white jelly, dead and stiff, with uncoiled arms, on the naked

floor of his prison. But introduce him while in health into an Aquarium where living sea-plants are perpetually revivifying the water, and where the bottom, varied with sand, gravel, and pieces of rock, imitates the natural floor of the sea, and you will soon see other particulars in the economy of our little friend, which will, I doubt not, charm you as much as they have pleased me.

The Sepiola is a burrower; and very cleverly and ingeniously does it perform a task which we might at first suppose a somewhat awkward one,—the insertion of its round corpulent body into the sand or gravel. Watch it as it approaches the bottom, after a season of hovering play, such as I have described. It drops down to within an inch of the sand, then hangs suspended, as if surveying the ground for a suitable bed. Presently it selects a spot; the first indication of its choice being that a hollow about the size of a silver fourpence is forcibly blown out of the sand immediately beneath the group of pendent arms. Into the cavity so made the little animal drops; at that instant the sand is blown out on all sides from beneath the body backward, and the abdomen is thrust downward before the cloud of sand which has been blown up settles, but which presently falls around and upon the body. Another forcible puff in front, one on each side, and another behind, follow in quick succession, the fine sand displaced at each blast settling round the animal, as it thrusts itself into the hollow thus more and more deepened.

I was not at first quite sure by what agency these blowings, so admirably effective and suited to the

purpose, were performed. The jet in front I readily attributed to the action of the fleshy funnel projecting from beneath the mantle on the breast; but I did not see how this could blow a stream directly backwards. I therefore put one of my pets into a vessel with glass sides, which was furnished with the requisite sand and water. I at once saw that the funnel was indeed the organ employed, and the only one, in every case; and perceived its beautiful adaptation for the work it had to do, in its extreme flexibility. This organ is very protrusile, and being perfectly flexible, its orifice can be, and is, at will pointed in any direction, so as to blow the jet of water forward, backward, or to either side at pleasure.

It frequently occurs, of course, that small stones are mingled with the sand, or the animal may find it convenient to burrow in the loose gravel. In either case the arms come to the aid of the funnel; the sucking-disks with which they are furnished being made to adhere to the stones, which are dragged out and thrown aside.* You may suppose this to be a clumsy expedient, but you would think differently if you saw it: the rapidity with which the arms are thrust under the body, and drawn out, bearing pieces of stone of comparatively large size, and the graceful ease with which they are then thrown forward, discharging and dropping the burden, impress the mind with admira-

* It is interesting to see that the removal of stones by means of the Cuttle's suckers had been observed by Homer:—

“ Ως δ' ὅτε πουλύποδος θαλάμης ἐξελκομένοιο
Πρὸς κοτυληδονύφιν πυκναῖ λαΐγγες ἔχονται.”
Od. ε. 432.

tion of the beautiful fitness of the organization for the requirement.

This use of the funnel, and of the sucking arms, so different from their normal purposes, affords additional examples of that Divine economy in creation, which, when a new function is ordained, does not always form new and special organs for the necessity, but adapts some already employed in other service for the new work ; while, still, both the one and the other function are fulfilled with such perfection, as shows that every emergency was foreseen and provided for in the mighty plan, and that it was not for want of resources that distinct actions are performed by the same instrumentality. We admire the skill of the artisan who can effect different operations with the same tool, especially when we see that each kind of work is of faultless excellence.

The ordinary employment of the sucking arms is no doubt the same as in other Cephalopoda, the capture and retention of prey. Of this I saw an instance in the case of one of my Sepiolæ which had seized a shrimp (*Crangon trispinosus*), a sand-burrower like itself, and was, when I saw it, holding it firmly against the horny jaws, which were devouring it. The discharge of ink through the funnel I have also witnessed, though this is far from being a frequent action with this species. One of them that had been for a day or two in an Aquarium, and was evidently at home there, I put into another vessel. No other animal was present, but the strangeness of the new abode evidently frightened it ; it darted about in manifest alarm and excitement, and presently shot forth from

its funnel a cloud of inky fluid to a distance of several inches ; another and another discharge succeeded in rapid sequence, and it was not for some time that the animal recovered its equanimity. It did not appear to me that this fluid could be of much service to the little creature in the way of concealment ; for, although the matter was tolerably copious and densely black, it did not diffuse itself in the water, but remained in masses, and when moved with a stick was drawn into slimy strings.

Perhaps the facts above recorded may not possess to others the novelty that they had to me. Dr. Johnston, in his admirable "Introduction to Conchology," has not included any species of Cephalopoda in his enumeration of burrowing Mollusca ; nor have I ever read of any that were known to possess the habit. I ought to have said that it takes place to no greater extent than to bring the animal just level with the surface of the sand, which is in general thinly spread over the posterior part. The eyes and the dorsal edge of the mantle are always exposed ; and if we carefully heap the sand over these parts, it is in a moment blown away by the action of the funnel, or removed by the undulation of the mantle-edge.

It would be unfair, however, if I were not to allow that the little Sepiole has some unamiable traits. The pretty bright-eyed Robin that so confidently picks crumbs from the window-sill, sad to say, fights spitefully with his fellows, and eats nasty spiders ! And I am sorry to confess that my little pet can be a real Cain at times. I saw one dart at an unoffending brother that was passing, and, seizing him with

murderous jaws, shed out his life in a few seconds. The poor victim shot his feeble column of ink, and sank white and motionless to the bottom, as soon as the ferocious grasp was loosened. The indictment which old Ælian brings against the whole race, that they are gluttonous ("terrible fellows for their belly"—*δεινοὶ κατὰ κοιλίαν*—is his phrase) and murderous, is, I am afraid, after all, not far from the truth.

CHAPTER IV.

When round thy wondrous works below
My searching rapturous glance I throw,
Tracing out wisdom, power, and love,
In earth or sky, in stream or grove :—
Let not my heart within me burn,
Except in all I Thee discern.

KEBLE.

How sweet is the coming in of Summer ! Many a brilliant day of sunshine the too willing heart greets as “ the glorious summer time,” which, after all, we are compelled to confess, is not the genuine thing ; and though it is pleasant, we reluctantly hurry in to the fireside again. But at last we say, “ This is the first real summer day we have had ! ” and there is really no mistake about it. Cold days may come, and will come after it ; but we feel that we have really tasted the sweets of the genial season ; she has looked upon us with her sunny, laughing face, and will not now go away again.

There was a delicious haze spread over cliff and bank as we set out, a family party, to enjoy a morning stroll near the end of May. I will not say it was “ formosissimus annus ; ” that was scarcely come yet ; but it was a true summer morning. White cloudlets were dimpling the blue heaven, and fleeting gaily along before the pleasant breeze, that imparted the

sensation of freshness without coldness. Away we tripped across the fields that crown the summit of Byng Cliff, treading on a soft and painted carpet of daisies and buttercups, pimpernel, clover and dandelion. The suburbs and villas looked attractive in their bowery groves, just flushed with green. Cock-chafers, with loud buzzings, were "wheeling their drony flight" round the brambles of the hedgerows, and Larks were singing by scores in the dazzling sky, now and then dropping to hover over the grass a moment, before they sank in. A sweet picture of innocent happiness does this bird present; he pours out his heart in thrilling song far above the world in the full beams of the bright sun, and then sinks to repose in his humble nest, where the embrace of love welcomes him, and his infant progeny call forth all his fondness and all his joy!

Hark to that little snatch of a song! I thought it at first some lad at work, whistling "for want of thought," so full and mellow are the notes: but no; it is a Starling in yonder cage. He repeats this bar every two minutes or so, with an interval of silence between. Flocks of Starlings circle round the fields, not yet reduced to slavery and the cage; and there the Poke-pudding flits by, trailing after him his more than sufficient longitude of tail.

We get into a lane, deeply cut up with ruts, and reduced in its narrow dimensions by heaps of rotting sea-grass bordering each side, on which we have to mount to allow the manure-cart to pass. The carter-lad, not unmindful of the elegancies of life, amidst his somewhat sordid employment, has decked the head

of his white horse with a rosette of cherry-coloured ribbons.

Everything is rich, luxuriant, and *promising*, in nature. The banks are crowded with the glossy, black-spotted leaves of the Wake-robin, and the young fronds of the Hart's-tongue Fern. The Germander Speedwell, that loveliest and most constant of spring flowers, peeps out with its laughing blue eyes everywhere from the rank herbage. Remembrances of last spring, and of its pleasant walks about dear Ilfracombe, come crowding over our hearts, like gushes of fragrance, or like the associations of some well remembered melody. We see the same flowers again—hear the same music—bask in the same sunshine. It is one advantage of the interchange of the seasons, that these associations are continually refreshed; we could not go on enjoying so vividly the delightfulness of summer, if it were not interrupted by winter. Every beauty bursts upon us with the charm of novelty, and yet with the peculiar claim of old acquaintance.

“O evil day! if I were sullen,
While the earth herself is adorning
This sweet May morning;
And the children are pulling,
On every side,
In a thousand valleys, far and wide,
Fresh flowers; while the sun shines warm,
And the babe leaps up on his mother's arm :—
I hear, I hear, with joy I hear !”

A lovely view suddenly opened seaward, which I could not resist the temptation of sketching as I sat on a gate. In front was a dell, chequered and parted into fields by hedge-rows, and merging at length into

a sort of ravine: cottages were scattered here and there. A low spit of rock runs out into the sea, where I was the other day searching for Actinias. The ruins of Sandsfoot Castle just peep over the brow of the slope; and beyond is the calm Bay sleeping under the sun, bounded by Portland with its breakwater and its throng of shipping. A little to the right is that wondrous barrier, the Chesil Beach, and outside that the vast expanse of West Bay and the British Channel.

My little boy interrupts me with " Give me some of those *shells*!" He points to the hedge, and I find that he means the young shoots of the Male Shield Fern coming up in great tufts, the points of each frond being curled round like a ram's horn, or still more closely like the shell of *Trochus magus*, which my little urchin supposed them to be. What a strange plastic imitative power there is in nature!

After a season in Devonshire, the scenery around Weymouth appears tame and mean, but this road is an exception to the rule. It is the back way to Wyke, leading past Belfield, the seat of Mrs. Buxton; and what with the rural character of the lanes, the woods that ornament the estate, and the fine views that occur, it is by far the most charming walk in the vicinity. Along the road-side there is a belt of wood, into which we took the liberty of straying, though I believe we were trespassers. However, the hoary and lichenized trunks of the trees, the cool shadow, and the rank herbage that covered the ground, tempted us too strongly. Among the coarse grass were many tufts of the stinking Iris, and the whorled stalks of the

PORTLAND, FROM BELMONT.



Wood Horsetail were piercing the turf; and between the oval plaited leaves of the Tway-blade, which was very abundant, the tall flowerstalk was shooting. The Beeches were just clothing their twigs with tender yellow leaves, and their beautiful grey smooth trunks were profusely embraced by the clinging Ivy. Everything wore a delightful freshness :—

“—— The sweet buds ——
Had not yet lost their starry diadems
Caught from the early sobbing of the morn.”

KEATS.

In the rough bark of an old willow I found half an hour's amusement, in obtaining a pocket-box-full of a very elegant but not uncommon shell, *Clausilia nigricans*. It is remarkable for having a sort of spring-door to its shells, composed of a shelly plate affixed to a highly elastic calcareous thread, which, while it allows the door to be pushed aside by the animal when it protrudes, closes tightly of its own accord the instant it withdraws. Dr. J. E. Gray calls this “one of the most wonderful contrivances employed by Nature for the protection of the Mollusca.”*

Birds were busy in the little grove, all intent on their own concerns, careless of our intrusion. Two Magpies were loudly brawling in a tree over our heads; Blackbirds all around were pouring forth their mellow notes ; one was sitting on the top of a tall post, flirting and opening his tail as he uttered his clear whistle, and in the very height of enjoyment : at my approach away he flies, finishing the strain as he

* Brit. Land Shells, p. 211.

glides along—(it was much too good to be left incomplete)—and resuming it the moment he alights. The Cuckoo's always welcome, always thrilling voice fell on our startled ears, and settled any lingering doubt of the reality of summer. A gay Greenfinch was busy among the lovely blossoms, crimson and white, that covered a crab-tree in the hedge; and, around the same bush, a large yellow Dragon-fly was pursuing his avocation of hawking for small insects.

'I hope my readers will be indulgent to me in repeating these details. I am sure they must have often enjoyed such scenes ; and I love to recall them, not only in the general effect, but in the minute particulars. I love to linger on the individual features of a pleasant scene ; for, in so doing, I am able in greater fulness to reproduce to my own mind the impressions awakened at the time. The delight we all feel in free, pure, wild nature is far too evanescent a thing ; the business and care of life, the stern realities of "this working-day world," rub off the imprint too readily ; let us stereotype it if we can.

But what connexion is there between all this and the Marine Aquarium? Well, I have said, be indulgent! I have been idling, I confess ; but still I am on duty. I am going down to the Fleet at Wyke for Actinias : yes, I assure you I am ; and presently I will show you the result. So farewell to birds, insects, flowers, and trees, while I make the best of my way onwards.

I will not tarry to cast a stolen glance at the straggling village of Wyke, with its fine old church tower that serves as a conspicuous landmark to mariners

coming up the Channel, but hurry through it, and across the fields to the sandy water's edge.

A curious and interesting scene was here before me; the tide was out, and the water was reduced to what looked like a shallow rivulet, scarcely more than a ditch in fact, with large patches of mud uncovered, green with confervoid plants. On the opposite side, to which one could have thrown a stone, rose a high beach of pebbles, on which several fishermen's boats were lying. This was the Chesil Bank, one of the most singular and most extensive ridges of pebbles in the world. It is a natural barrier thrown up by the sea, sixteen miles in length, consisting of smoothly rolled pebbles of white spar, quartz, jasper, &c., which regularly diminish in size from that of an egg (their dimensions down here) to that of a horse-bean at Abbotsbury, and thence to mere fine gravel. This bank, which connects Portland with the main, divides from the sea of West Bay a very narrow inlet called the Fleet, which runs up to a length of ten miles, and forms at the extremity a swannery of about a thousand swans. The creek is the resort in winter of the Wild Swan, as well as many other species of water-fowl.

I was curious to observe what zoological features so remarkable a water might furnish; and though I did not obtain much, some peculiarities were noticed. The little pools left isolated, and the shallow indentations of the muddy shore, were tenanted by multitudes of little fishes, which were lying motionless in great numbers, but shot away so invariably on the approach of a footfall that it was difficult to ascertain their

nature. By perseverance, however, I captured several, and found them to be the One-spotted Goby (*Gobius unipunctatus*) ; a tiny fish about two inches long, and well marked by a spot of rich dark blue on the dorsal fin. It proved a lively and pleasing tenant of the Aquarium.

Lying flat on the mud, in many cases with not more than an inch of water above them, enjoying the light and warmth of the sun, were multitudes of *Pleuronectidae* of several species, such as the Brill, the Plaice, the Dab, and the Sole. All that I saw were very young, from an inch to two inches in length. Though easily caught, they are of little value, for they do not live long in a tank, and are uninteresting from their sluggish habits, as they lie perfectly still on the bottom for hours together, trusting for concealment to the similarity of their russet colour to that of the sand.

By digging in the sand some specimens of the Launce (*Ammodytes*) were discovered; a slender silvery fish, which has the habit of burrowing into the wet sand on the retreat of the tide; and also some Bivalves, as *Pullastra aurea*, and *Venus casina*. But the most interesting thing to me was the great multitudes of *Actiniæ* that were expanding their flower-like disks on the surface of the mud beneath the shallow water. I was for some time disposed to consider this as a strange species, partly from its colour, but principally from what appeared to me its unusual locality and habit; but I am at length persuaded that it is the Daisy Anemone (*A. bellis*) ; though widely differing from those individuals which dwell in the hollows of the honeycombed limestone near Torquay.

Actinia bellis in this situation is externally of a dull wainscot-yellow hue, paler towards the base, which is usually buried in the mud. The disk is blackish brown, freckled with grey and white spots, and the tentacles are similarly coloured. In other particulars, as of form, arrangement and number of the tentacles, &c., it agrees with the normal state of the species; but the body is thicker in proportion to the disk, which has not the same tendency to assume the appearance of a shallow cup.

This was not the first occasion on which I had met with this variety of the Daisy Actinia. A few days before this I had taken a run up the inlet called the Backwater, and had seen, towards the upper end, in the shallows of the western side, a great number of dull yellow objects scattered over the mud of the bottom. You would suppose them to be pebbles; but on taking one up,—which you may easily do with your hand if you are in one of those little flat-bottomed skiffs that are here called troughs, but at Poole bear the appellation of canoes,—you perceive that you have captured an Actinia. The soft, slimy, fetid mud affords no proper surface for adhesion; and hence the Anemones can scarcely be said to adhere in the manner of the genus, but simply to rest on their basal disk. This, however, is not owing to any defect in the power of adhesion, for, on being removed into a vessel of sea-water, they are soon found clung fast to the bottom and sides.

In one case I observed the interior of the stomach protruded from the mouth, in the form of two flat corrugated semicircular lobes of a greyish hue, that

quite concealed the disk. Presently afterwards I perceived that this individual had just given birth to two young ones, one of which was still adhering to the edge of the mouth. I attempted to remove it, but it resisted ; at length it came away, dragging a third young one, which was attached to it, out of an orifice situated at the extremity of a line that divides the protrusile lobes from each other. After the birth, I examined this orifice with the lens : its edge appeared lacerated or jagged, and I found that it led, not into the stomach, but into the cavity surrounding the stomach. I then searched at the opposite extremity of the dividing line, and found a corresponding orifice into which I could readily insert a pin without the least resistance till it reached the sucking base. A good deal of the contorted filaments commonly called ovarian, was discharged from both orifices, which, lying about, concealed them from view until searched for.

THE LONG-TONGUED MEDUSA.

I continued my walk over the Ferry Bridge, and along the ridge of pebbles, to the fishing village of Chesil. It has an aspect of venerable antiquity, arising chiefly from its being built, even to the poorest fishermen's huts, of massive stone ; the door-posts, the window-sills, the lintels, all of the grey freestone which constitutes the staple of the island. The vast overhanging cliffs of the west side add to the grandeur and impart an awfulness to the scene, which reminded me of an exhumed town. The people visible were few, and those were still, grave, and seemingly only

half awake, quite unlike the "fast living" people that one is accustomed to see in these days. Two or three sailors lounging in as many of the little stone-porches, a superannuated fisherman with palsied fingers weaving a mat of spunyarn, a little girl with pitcher on her shoulder going for water to the brook, and a woman or two half up the steep, and almost over the houses, hanging out clothes, made up about the sum total of the moving population.

Indications of the habits and doings of the village, however, there were. At every second door nets were hung out to dry; and pieces of water-logged timber, splintered and torn by tempests, collections of rusty nails and iron work, crumpled sheets of green copper, old blocks, and fragments of cordage, were heaped up beneath the windows, or lay in the porticoes at every turn. Fishing and wrecking were evidently the characteristic means of living here.

I walked along the margin of the shore, where the transparent wavelets of the wide, horizonless sea were washing the pebbles, and producing a constant succession of whispering cadences, that fell musically, the voices of the "many-sounding sea." Medusæ, by scores, were washed up; the common *Aurelia aurita* lying helpless on the shingle like cakes of jelly, each marked with four rings of purple. These were the first Acalephs I had seen this season, and well pleased I was to see them.

Wearisome walking it is over the pebbly beach; the loose stones give way beneath the tread, and at every step the foot sinks in above the shoe-top. How wonderful to reflect that, with such an apparently

feeble, ever-shifting material, the Almighty has curbed the wildest fury of the raging sea, and made its very rage build up its own barrier !

"Who shut up the sea with doors, when it brake forth as if it had issued out of the womb ? When I made the cloud the garment thereof, and thick darkness a swaddling band for it ; and brake up for it my decreed place, and set bars and doors ; and said, Hitherto shalt thou come, but no further ; and here shall thy proud waves be stayed ?"—JOB xxxviii. 8—11.

Several mackerel boats were hauled up on the beach, and, while I stood, a party of stalwart fellows in Guernsey frocks and deck boots came running down with rudder and oars, and, launching one of the skiffs, put to sea ; for a report prevails that a shoal of Mackerel had been seen in the offing, their first appearance this season. Enormous lobster-pots lay about, to which those used in Weymouth Bay are toys ; and a stout rope, beset at intervals with great cork-floats, displayed the device by which the position of these cages is marked, and the manner in which they are raised for examination ; while just off shore a line of well-boxes was floating, in which the captured Crustaceans are kept prisoners of war, till occasion serves for conveying them to market.

Beyond the village the beach gave way to an iron-bound shore, strewn with boulders and fallen masses of stone, vast in dimensions, angular, smooth and white, heaped on each other in wild confusion. The sea washed in among them, passing freely into their interspaces, but not forming pools. Hence very few sea-weeds were growing here, the surfaces of the rocks being ever liable to be laid bare by the dashing of the

unmitigated surf. There were, however, on the perpendicular and overhanging sides of the blocks, a few tufts of that peculiarly beautiful, silky, bright-green *Confervæ*, *Cladophora gracilis*, and one or two of the equally lovely, crimson-pencilled *Callithamnion corymbosum*. *Trochus crassus*, a rather rare shell, was adhering to the rocks.

Here I found myself once more among my favourites, the charming little Naked-eyed Medusæ. It was nearly high-tide, and the sea had the brilliant crystalline clearness of spring-water: though, on minute examination, it was seen to hold in suspension millions of filmy bodies, the exuviae of the countless acorn-barnacles (*Balanus*), that stud the lower rocks.

Standing on the huge angular blocks, I dipped with a ring-net at the end of a staff, and up came several balls of clear jelly, which when turned into a glass jar of water proved to be fine specimens of *Sarsia tubulosa*. Again and again the net went down, and at every plunge brought up more of the same species, which could be distinctly seen, on bringing the eye nearer to the water, playing by scores in the sea, almost wherever I looked.

Another species not less interesting, *Bougainvillæa Britannica*, accompanied the *Sarsiæ*, but not in any considerable numbers; and there were a few of that lovely animated crystal globe, *Cydippe pomiformis*, and a small *Thaumantias* or two, and many of those curious, slender, fish-shaped animalcules, named *Sagitta*, some of them twice as large as those I had seen at Ilfracombe, but apparently of the same species.

A week or two later than this, namely at the end of

May, I found the *Sarsia* even more abundant around the boulders at the Nothe Point. They were accumulated by hundreds if not thousands, shooting hither and thither near the surface of the clear water, in the narrow interstices of the rocks, and in the little inlets, borne in by the incoming flood-tide.

The size, the perfect transparency, the elegant form, and the extraordinary vivacity of this species render it one of the most interesting of the Medusæ, for keeping in a glass vessel of sea-water. Its shape is that of an ellipse, of which about a third has been cut off at one end ; a tall bell of the purest crystal, a little narrowed at the mouth. At four equi-distant points on the margin of this bell are placed as many knobs, within each of which is a bright red speck, and from every one of the knobs depends a tentacle resembling a slender thread. Often these threads are shrivelled up till they are not more than a quarter of an inch long ; more commonly they are about an inch and a half in length, but occasionally, when the *Sarsia* rests motionless in the water, a little turned over on one side, its tentacles are allowed to hang down in the deep to a great length ; five inches I have seen them extended, as measured by a rule placed against the side of the glass. When thus stretched, they appear like a thread of excessive tenuity ; but if you look very closely you may see even with the naked eye that it is not a simple thread, but rather a string of the most minute white beads, which when placed under the microscope are discovered to be a series of thickened knobs, arranged in an imperfect spiral round the central filament.

But the most remarkable and conspicuous feature in this Medusa is the peduncle, which depends, like the clapper of a bell, from the centre of the roof. This is a somewhat thick, fleshy, cylindrical organ, capable of energetic movements, and particularly of enormous elongation and contraction. Sometimes it is shortened so as to be wholly contained in the concavity of the bell, being more or less curled up at the same time; at others it is lengthened and allowed to protrude far beyond the margin, hanging down,—not merely to “twice the length of the body,” as Professor Forbes says;—this gives a very inadequate idea of its powers—but *to five times that length*. I carefully measured one which was lying quite still, near the side of the glass (a vessel with *straight* sides, so that there was no irregular refraction), by applying an ivory scale to it; the peduncle was twenty lines in length, though the bell was scarcely four. The basal part of this long tongue is abruptly diminished to a mere thread, and though this is not conspicuous when the organ is contracted, it becomes a marked character in the extended condition; in the case I have just mentioned the thread-like neck formed just one-third of the whole length, itself reaching far beyond the margin of the bell.

The motions of the *Sarsiae* are more energetic than those of any other Medusa that I am acquainted with. In the unbounded freedom of their native sea, and in the limited dimensions of a glass vase, they are alike rightly. By rapid pump-like contractions of their umbrella, they dart through the water, and shoot round and round, almost with the force and swiftness of a swimming fish. The summit of the bell always goes

foremost, whether the direction of the movement be vertical, horizontal, or, as is most commonly the case, oblique ; and the tentacles, and the long white proboscis, drag behind in trailing lines. Now and anon, the shooting is suddenly suspended, the bell hangs over and remains awhile motionless, the tentacles are allowed to depend like spiders' webs, or are suddenly drawn up into shrivelled puckers, become mutually entangled and intertwined, then slowly free themselves and hang down again. Sometimes the motionless bell itself sinks very gradually, and the tentacle-threads take the most elegant curves and arches in their descent.

The *Sarsia* is voracious, and the long and flexible peduncle is not only the stomach which digests the prey, but the hand that stretches forth to seek and to grasp it. I put into the bottle containing several the minute green-eyed fry of some fish, newly hatched, about half-an-inch in length. In a very few minutes I saw that a *Sarsia* had caught the little fish, which was seized and partly swallowed by the clubbed extremity of the peduncle. For hours afterwards the prey was visible, though more and more engulphed ; the large head and prominent green eyes of the victim being very conspicuous.*

* Professor Agassiz, with whose masterly tract on a closely allied species I was not at this time acquainted, states that *Sarsia mirabilis*, with all the small Naked-eyed Medusæ of the North American coasts, disappears about the middle of summer, being killed by the heavy rains of that season. (Mem. Amer. Acad. iv. 228.) If I were to judge only by my Weymouth experience, I should say our Naked-eyed Medusæ conformed to the same rule ; as, though I searched often in various situations, I scarcely obtained an individual of any species after the date above mentioned. Yet, in the Bristol Channel, many

PEARL-SHELLS.

Of the shelled Mollusca which the dredge ever and anon brings up, the *Trochi* are among the most conspicuous for beauty. *T. ziziphinus* is exceedingly common in deep water, and not rare within tide-marks. Its very regularly conic form, and the blotches of dark purple that run in a spire round and round the shell, are pleasing to the eye; and the animal, which crawls freely in confinement, is richly coloured, being of the tint of a ripe melon, striped with black. (*See Plate I.*) One or two specimens of a pure white variety of this species have occurred to me.

Though this is a shell of considerable size, it is exceeded in that respect, and (in the estimation of some, probably) in that of beauty also, by *T. granulatus*. The latter is esteemed a somewhat rare shell; but in this Bay, and off Portland, it is not at all uncommon. In shape it is equally elegant with the former, the shell tapering to a conical point, and displaying a surface sculptured with spiral raised lines, each of which is composed of a number of minute rounded knobs, like a string of beads. Its texture is somewhat fragile, and its colour a faint flesh-tint or yellowish white, slightly dashed with purple.

In captivity the animal is rather chary of displaying itself; which is the more to be regretted since it is

kinds, from the minute *Turris neglecta* upwards, swarmed during the months of August, September, and October, in 1852; and it is generally considered that the latter part of summer and autumn is the most favourable season for studying all the Medusæ of our coasts.

large and handsome. The large lappets on each side of the neck, and the wing-like appendages of the mantle, furnished with tentacular filaments, are conspicuous when it crawls; though these parts are less vividly coloured than in its more common congener. Neither species, unfortunately, thrives, according to my experience, in an Aquarium; they sometimes obstinately refuse to protrude from the very first, and, after lingering a few days, die where they were put in.

The chief glory of this genus is the richly pearled internal surface of their shells, in which they are not excelled by any, even of the true margaritiferous bivalves. Both of the species I have named are very brilliant, and it might be worth while to experiment on them in the manner in which it is reported that pearls are artificially produced by those ingenious rogues the Chinese. Dr. Gray says that they introduce little pieces of silver wire, bent into a peculiar form, between the mantle of the pearl-oyster, while yet alive, and the shell—not perforating the shell, as has been sometimes stated. This zoologist himself tried the experiment on the *Unio*, a bivalve of our fresh waters, and was very sanguine as to its success;—but I have never heard of any one having suggested the formation of pearls by the *Trochì*, though, as these beautiful objects are produced spontaneously by some univalves (as *Strombus*, for example), I do not see why it may not be possible. The origin of loose pearls is known to be the irritation caused by some extraneous body, to get rid of which the secreting surface of the animal throws off, in unusual quantity, the brilliant nacreous matter. This, investing

the offending substance, conceals its points and roughnesses, and, in process of time, becomes round by the addition of successive coats of pearl.

May not the Christian learn the happy art of converting every "thorn in the flesh" into a pearl for his heavenly diadem? "For these light afflictions, which are but for a moment, work out for us a far more exceeding and eternal weight of glory."

THE GOBLET LUCERNARIA.

The shore of the Bay known by the name of Belmont, curving between the Nothe and Byng-Cliff, consists of a series of low ledges almost horizontal, running east and west, with a very gentle dip to the southward. They are for the most part densely covered with a matted drapery of *Fucus serratus* and *canaliculatus*, which hangs over the northern edges, and conceals the narrow clefts that traverse them. If we go at low water as far down as we can reach, and lift the heavy masses from the ledges, and from the clefts, we shall find them no unprofitable hunting ground. Many kinds of delicate sea-weeds grow under the shadow of the coarse olive Fuci, and among them crawl many Nudibranch Mollusca and other interesting creatures.

It was here that I met with the Goblet Lucernaria (*L. cyathiformis*), apparently a rare species, since it seems to have been seen by only two observers, the Norwegian zoologist Sars, who first described it, and Dr. Landsborough, who gave it a place in the British Fauna, by finding it on the coast of Arran. Dr. Johnston has given in his British Zoophytes, p. 475,

a short description and a figure taken from this latter specimen. The specimen which I have found is evidently identical with this, though there are some differences in the form.

When extended, it stands about one-third of an inch in height, shaped like a goblet, with an oval body, somewhat flattened, being broad in one aspect, and thin in another at right angles to it. This is perpendicularly corrugated, so as to form four irregular lobes. Above the body there is a decided neck or constriction, not indicated in Dr. Johnston's figure, above which the tentacular disk expands much like the mouth of a phial. Below, the body is supported by a corrugated footstalk, capable of considerable extension and contraction, terminating in a flat, dilated, sucking disk.

Viewed from above, the tentacular disk is seen to be a pellucid gelatinous membrane, of a form indistinctly stellar, with eight points. The spaces between the points are furnished with tentacula, about twelve in each space, which are short, rather crowded, and set in three rows, a little overarching the margin. Those in the middle of the interspace are the longest, and the length diminishes on each side: the points themselves are destitute of tentacles. The tentacles are composed of a thick cylindrical stem, which has a central opaque core; and a globular white head, which, under a power of 200 diameters, showed neither hairs nor ciliary action, but appeared viscous. The tentacles originate *without* the margin of the disk, for the edge of the latter is distinctly traced *within* their bases.

The delicate transparent disk is shallowly funnel-

shaped, descending abruptly in the centre, where rises a cup-like mouth of a greenish hue, formed of thin membrane, capable of considerable motion, sometimes taking a circular shape, and at others wrinkled into four lobes or lips, strongly reminding one of the peduncle of many *Medusæ*. Each of these lobes corresponds with one, taken alternately, of the marginal angles, as do also four black spots, rising from the interior of the body, and projecting into the disk immediately around the mouth. These spots are the summits of as many dark bands that are seen running down the body longitudinally, and which appear to be connected with the ovaries, for each of them is bounded by a series of pale egg-like bodies, the upper extremity of each series running off in a number of globular white corpuscles towards each of the eight marginal interspaces.

The general colour of the animal is a pale dusky brown or grey, the tint becoming warmer in some parts. The translucency of the integument reveals the internal organs, and hence the light and dark bands already spoken of are conspicuous.

When I discovered the little creature it was attached by its foot to a fragment of rock. For convenience of examination I gently dislodged its sucker, as I would have removed an *Actinia*, supposing it would soon adhere to the sides of its vessel. While I have had it, however, it has showed no inclination to refix itself, but lies at length on the bottom. The tentacular disk is habitually expanded, and it is not at all timid or impatient of handling. If rough usage be applied, and especially if it be lifted out of the water, it pre-

sently enfolds the margin to so great an extent as nearly to conceal the tentacles. The footstalk is also contracted by corrugation, but no sooner is it immersed again than this is lengthened, and the tentacles are expanded as before. The changes in the outline of the lips, and slight jerkings of the body to and fro, or corrugations of the surface in various degrees, constitute the chief of its movements.

On cutting off the globular head of a tentacle and submitting it to pressure, I found the structure to contain a moderate number of minute thread-capsules, about $\frac{1}{100}$ th of an inch in length, of two forms :—the one long-oval, apparently carrying a simple thread ; the other oval, with a distinct internal chamber near one end, indicating an armature on the thread. The threads were projected from the former in several instances, but I saw no example of the propulsion of the latter.

I afterwards obtained a second specimen of this little *Lucernaria*, on a similar rocky ledge which runs out from the eastern point of Lulworth Cove. In every respect it agreed with the one above described, which may therefore be considered as representing its normal condition. Though inconspicuous for size or colour, it is a form of much interest to the naturalist, as it is evidently much less aberrant from the Actiniæ proper, with which its affinities connect it, than the broad gelatinous-disked species to which the genus *Lucernaria* was confined before the discovery of *L. cyathiformis*. Though still peculiar, the form is not very remote from that of the genus *Corynactis*, by which, as I conceive, it is linked with *Actinia*.

CHAPTER V.

How various the shades of marine vegetation,
Thrown here the rough flints and sea-pebbles among !
The feathered *Conferva* of deepest carnation,
The dark purple *Sloke*, and the olive *Sea-thong* !

CHARLOTTE SMITH.

EVERY one who has paid a visit to Weymouth is familiar with the Nothe, an elevated promontory that juts out a considerable distance to the eastward, forming the southern boundary of the harbour. It is a favourite walk ; and great numbers of persons climb on a summer's afternoon the steep steps that lead up to its grassy summit, whence they turn, and cast a glance at the busy ship-yard and the narrow harbour lying beneath their feet, and, beyond the pier, at the crowded esplanade receding in its sweeping curve till it is lost in the distant shore. The long and lofty barrier of this headland affords a most valuable shelter from the violence of the south and west winds, completely protecting the harbour in this quarter ; and the benefit thus gained is often sensibly appreciated when, from the quiet calm below, we mount the ridge and suddenly encounter the force of a breeze that is curling the waters of the Bay, and covering the dark green space between us and Portland with broad sheets of driving foam. The extremity of the promontory is occupied by the premises of the Coast-

guard, whence those hardy fellows are often exercised in artillery practice, firing their one great gun at a signal fixed on a buoy some mile or two out at sea.

A fine and substantial jetty of hewn stone has been built out from the base of the point, lengthening the harbour; on the end of which a large lamp lighted with gas from the town indicates the entrance to the port in the hours of darkness. For the protection of this important work from heavy seas, which are apt to prevail from the south and east, and which have ere now proved very injurious to it, a sort of breakwater has been formed about thirty or forty yards off, which is called the Mixon. It was made by throwing large stones overboard, until a heap was accumulated, sufficient to appear above the surface. The action of the waves settled their angles one with another, and gradually gave the mass considerable solidity; and it now appears as a low island of rocks, covered at ordinary high tides.

Within the numberless crevices of this mass of unshapen stones, which run down to considerable depth, though without possessing that isolation of the contained water which would constitute them pools, grow *Algæ* of many species in more than littoral vigour. The margins of the heap, especially the shoreward margins, which enjoy a more protected sea, are fringed with luxuriant tufts, and the surfaces of the individual blocks are studded with hundreds of fine specimens. In fact it is a varied, well-filled, and fertile garden of marine botany, and the algologist who may visit Weymouth will find it well worth his while to explore

the Mixon. It can be reached only by means of a boat, and can be examined only at low water of spring-tides, and then only (at least with any comfort) provided no sea is running, as otherwise the breakers wash over the mass, and prevent examination. A wet foot is pretty sure to be an accompaniment of the expedition; for the angular blocks, offering here only projecting points, and there surfaces sloping in all angles of obliquity, and draped with wet and slippery beds of *Enteromorphæ* and other weeds, afford but a precarious foot-hold for one used to these rough rocks, and to an unpractised tread are sure to prove treacherous. In summer, however, a partial immersion in these crystal waters is an evil of no terrible magnitude.

The *Laminariæ* luxuriate on the shelving outer margin, and toss their broad brown fronds to and fro in the 'rolling seas, like forest trees that rock in the gales of autumn. But it is chiefly the red and green families of *Algæ* that flourish here; the Winged and the Sinuated *Delesseriæ*; the excessively ramified *Plocamium*, whose brilliant crimson trees are so much in demand by those who make mimic landscapes out of dried sea-weeds; the pencilled *Polysiphoniae*; the brush-like *Dasya*; the feathery *Ptilota*; and various species of elegant *Ceramia*, so easily recognised by their regularly jointed stems and double incurved tips; and the tender *Callithamnia*, among the most delicately lovely, though the most minute, of marine *Algæ*. Several species of *Cladophora*, also, here spring from the rocky surface in greater or less abundance, forming pencil-like tufts of various hues of green, some indeed

dull and sombre, but others brilliantly vivid and silky. And, besides the large lettuce-like leaves of *Ulva*, which here attain unusual size, great patches of rock are covered with the equally large and still more tender fronds of *Porphyra*, of a brownish-purple tint, bearing no small resemblance in texture and surface to gold-beater's skin, and which in the esteem of some persons, perhaps, presents the sole redeeming trait of "utility" amidst a Class proverbially "vile," since it contributes to the indulgence of their appetite. For this is the Sloke, or Laver, which, being stewed to jelly and served up with lemon-juice, is a favourite dish at the tables of many. For myself, I am free to confess that the exquisite beauty of form and colour displayed by many of these humble plants; the delicacy of their simple structure; and the purposes which they evidently serve in the great chain of being, of which it has been truly said—

"From Nature's chain whatever link you strike,—
Tenth or ten thousandth,—breaks the chain alike;"—

are sufficient qualifications to redeem them from the baseless charge of vileness, even without any pretensions to sapidity.

And while I am speaking of beauty, I will mention a species of sea-weed that possesses it of a very peculiar character, and in an extraordinary degree. It grows in the vicinity of the Mixon, though not exactly on it; and indeed this is the only locality in which I have met with it. It is the *Cystoseira ericoides*. Between the Mixon and the end of the jetty, in about a fathom's depth, we discern, as the boat

glides smoothly along, a bush here and there of large size springing from the bottom, conspicuous above the olive and purple bed of common weeds by its light greenish grey colour. These are the plants in question. It is difficult to procure a growing specimen, for the rocks to which the plants are attached are here all rather large and heavy masses, and the depth of water even at low-tide prevents the use of the hammer and chisel. By means of a boat-hook, however, I have torn up considerable portions of a shrub, from which I have then carefully severed uninjured branches, which, being bound to the surface of a shell or stone, survived some time in an Aquarium, and displayed their remarkable gorgeousness of colour to great advantage. None of this is visible when the specimen is removed from the water; it is a shrub with stout compact branches of a pale yellowish-olive hue, set with needle-like leaves, whence its trivial name of *ericoides* or "heath-like;" while another marked character is the swelling of the branches into oval air-bladders, which, though solitary in this species, more generally run in strings of several in succession, as indicated by the generic name *Cystoseira* or "bladder chain." But the moment the plant is submerged all its glory returns: the pale olive branches become invested with a most brilliant flush of iridescent light blue, not changeable in tint, though varying in intensity according to the play of light that falls upon it. Thus it may be compared to some Christians, who are dull and profitless in prosperity, but whose graces shine out gloriously when they are plunged into the deep floods of affliction.

MY OWN TANK.

As the principal subject of these pages is the Marine Aquarium, including, and indeed subsidiary to, the history of the plants and animals which it enables us to keep under our observation, it may not be impertinent in me to give some account in detail of my own. Hitherto I had contented myself with cylindrical glass vases, ten inches in height and five in diameter, which answer admirably for small objects; with wide shallow pans of yellow and white ware; and with a foot-bath of the latter. These, though affording opportunity for many interesting observations, were deficient in some points, which would be supplied by a tank of ampler dimensions, with parallel sides to prevent unequal refraction and consequent distortion, and made wholly of plate-glass, to allow distinct vision in every part.

Such a vessel I have had made under my own direction; and as it will be the chief medium of most of the notes that occur in the subsequent pages of this work, I will describe in detail its dimensions, form, and structure; the mode in which I filled and stocked it; with some accounts of failure and disappointment to serve as beacons, as well as of success to stimulate with encouragement. I do not hold it up as a perfect example, but as an essay actually made, "with all its imperfections on its head."

The tank is 2 feet long, $1\frac{1}{2}$ foot wide, $1\frac{1}{2}$ foot deep; the sides and ends of $\frac{3}{16}$ ths plate-glass; the bottom of slate; the corners of birch-wood, turned into pillars, each surmounted by a knob, and united by a frame top

going all round. The glass is set in grooves in the slate and wood, and fastened with white-lead putty. I first stocked it before the emanations of the putty &c. had sufficiently gone off; and hence the plants and animals died almost as fast as they were put in, rarely surviving the first night, although the water was renewed from the sea once and sometimes twice a day. The Mullet-fry and a few Actinias alone survived the experiment, which was continued for a week.

At the end of that time I emptied it, had it carefully cleansed and rinsed with fresh water, and allowed it to remain in the open sun and air for a week, when I judged all smell from the paint had ceased.

I now refilled it. The mode in which this was done was as follows. First I laid on the bottom a stratum of stiff blue clay, varying in thickness from two inches to half-an-inch. On this a layer of small pebbles, coarse gravel, fine gravel, and sand, was put, so as to afford varieties of bottom. Then pieces of rock were carefully put in, so selected and arranged as to make arched passages and overhanging shelters, with one mass rising pyramidal to within a few inches of the surface.

The sea-weeds, attached to fragments of stone, were now introduced; the larger and heavier on the bottom, the smaller and more delicate laid on the ledges of the rocks, or inserted into the crevices. Among the former was a large tuft of *Furcellaria fastigiata*, two of *Chondrus crispus*, two of *Rhodymenia palmata*, one of *Dictyota dichotoma*, a small plant of *Fucus serratus*, one of *Laminaria digitata* (young), two tufts of *Padina pavonia*, and several

masses of *Corallina officinalis* in the encrusting state. Among the latter were three tufts of *Griffithsia setacea*, one of *Delesseria alata*, two of *Plocamium coccineum*, and one large and one small bush of *Phyllophora rubens*. To these were added, about ten days afterwards, a mass of *Zostera marina*.

About twenty gallons of sea-water, dipped from the quay steps while the tide was coming in, were poured into the tank, a plate being held under the stream, to prevent the displacement of the contents by the falling water. It was rather turbid at first, but soon cleared, and in about two days became quite crystalline, except a slight tinge of green, which always remained ; not enough to alter the hue of any object in the vessel, but perceptible, by contrast with the clear air, when the whole body of the fluid was looked through.

No animals were *put* in till the third day, but from the weeds multitudes of minute creatures swarmed forth, quite peopling the water. At night the application of a candle revealed a vast number of tiny animals clinging to the sides, and visible through the clear glass ; Annelides of the genus *Syllis* ; *Rissoæ* and other minute shell-fish : but principally Isopodous and Entomostracous *Crustacea*, for the most part so small as to require a lens for their detection. The careful examination of the water with the triple power of a pocket-lens made manifest also that an immense number of *Infusoria* and some *Rotifera* were tenanting the tank.

These, especially the *Crustacea*, could be drawn to any part of the vessel by the moving of the candle ; for when this was placed within an inch or two of the

side, the living atoms would presently be seen crowding up to that part by myriads, and studding the glass in the vicinity, just as if it were covered with fine dust. I subsequently availed myself of this acquaintance with the habits of the Entomostraca, to provide food for the smaller fishes; for I found that they soon disappeared, not a trace being left of their presence after the Tank had been stocked a few days, they doubtless having been devoured by the Wrasses and Mullets. I therefore gathered some tufts of the more bushy sea-weeds, and allowed them to remain floating in the Tank for an hour or two in the evening, a candle being placed outside. The result was the same as I have described; the vast numbers that swarmed out were really astonishing; and I was pleased to see the little Mullets flock up to the spot where the light revealed the tiny prey, and pick the atoms from the glass, one by one, as fast as they could seize them; and yet the hosts crowded on, faster than they could be devoured.

The animals of which I could take distinct cognizance were as follow.

1	Fifteen-spined Stickleback	<i>Gasterosteus spinachia</i>
7	Grey Mullet (young)	<i>Mugil capito</i>
1	Black Goby	<i>Gobius niger</i>
1	Corkwing	<i>Crenilabrus Cornubicus</i>
1	5-beard Rockling	<i>Motella 5-cirrata</i>
1	Great Pipefish (young)	<i>Syngnathus acus</i>
1	Deep-nosed Pipe	" <i>typhle</i>
2	Worm Pipe	" <i>lumbriciformis</i>
2	Ashy Top	<i>Trochus cinerarius</i>
1	Navel Do.	" <i>umbilicatus</i>

3 Common Periwinkle	<i>Littorina littorea</i>
3 Yellow Do.	" <i>littoralis</i>
1 Purple	<i>Purpura lapillus</i>
1 Scrobicularia	
1 Anomia	
2 Common Cockle	<i>Cardium edule</i>
5 Ascidia	
2 Hermit Crab	<i>Pagurus Bernhardus</i>
1 Do.	" <i>Prideauxii</i>
4 Sand Shrimp	<i>Crangon vulgaris</i>
1 Prawn	<i>Palæmon serratus</i>
3 Crown Worm	<i>Serpula triquetra</i>
3 White-lined Worm	<i>Nereis bilineata</i>

2 Thick-horned Anemone	<i>Actinia crassicornis</i>
3 Weymouth Do.	" <i>clavata</i>
2 Parasitic Do.	" <i>parasitica</i>
6 Plumose Do.	" <i>dianthus</i>
5 Daisy Do.	" <i>bellis</i>

The *Actiniæ* were dispersed about the pieces of rock, in the reticulate cavities of a large piece of *Eschara foliacea*, and in the holes of Coralline-covered stones. The *Serpulæ* and the *Ascidiae* were attached to Oyster shells, as was the *Anomia*; the other animals, being vagrant, chose their own resting-places and wanderings.

In about a week after the original stocking, the following animals were added to the collection in the Tank :—

1 Aequoreal Pipefish	<i>Syngnathus æquoreus</i>
1 Rough Doris	<i>Doris pilosa</i>

2	Magus Top	<i>Trochus magus</i>
1	Nerite	<i>Natica Alderi</i>
1	Squin	<i>Pecten opercularis</i>
1	Pholas	<i>Pholas parva</i>
1	Pisa	<i>Pisa tetraodon</i>
1	Cleanser Crab	<i>Portunus depurator</i>
1	Ebalia	<i>Ebalia Pennantii</i>
1	Hermit (small)	<i>Pagurus</i> — ?
3	Lobster-prawn	<i>Athanas nitescens</i>
1	Brittle-star	<i>Ophiocoma rosula</i>
1	Eyed Cribella	<i>Cribella oculata</i>
2	Scarlet Sunstar	<i>Solaster papposa</i>
1	Birdsfoot Star	<i>Palmipes membranaceus</i>
3	Gibbous Starlet	<i>Asterina gibbosa</i>
1	Purple-tipped Urchin	<i>Echinus miliaris</i>
7	Scarlet Madrepore (from Ilfracombe)	<i>Balanophyllia regia</i>
3	Cloak Anemone	<i>Adamsia palliata</i>

Thus there were nearly a hundred animals in this Tank ; a number which I found far too great ; for though they did not crowd the vessel at all apparently, nor seem disproportioned to the space they occupied, it became evident that the exhaustion of the oxygen of the water went on more rapidly than it could be renewed, either by the evolution from the living plants, or by the combination with this of artificial aeration, by allowing two or three gallons a day to drip from a vessel suspended over the Tank at the height of about four feet.

For about ten days the animals appeared pretty well ; a little diminution occurring from the assaults of the predatory species on their weaker fellows. Then

many of the more delicate began to grow sluggish and manifestly unhealthy ; some of the Fishes, of the Mollusks, particularly the univalves, and the smaller Crustacea, died off one by one ; and the water began to have a tainted odour, arising, as I discovered, from the carcases of some of the animals that had died beneath the shelter of the stones.

The whole contents were therefore removed : the plants and animals,—such of them, at least, as appeared in health,—being temporarily placed in a pan, while the water, sand, gravel, and clay were thrown away, the interior of the tank well cleansed, and refilled with new materials. With these I got on better ; though, as it was always an object with me to have as many animals under observation as possible, I did not care to confine the number to such as would maintain the balance with the plants. I preferred to change the water periodically, as the sea flowed invitingly up to the very door, and accordingly renewed it regularly about once in three weeks.

THE BLACK GOBY.

This fish (*Gobius niger*), of which I had several about three inches long, soon became tame, feeding readily. After a few weeks they would come out of their shelter as soon as a stick was put into the water, and at length grew so bold as to snap at and seize the stick. A little Two-spot Goby (*G. Ruthensparri*) elicited the cannibal propensities of his black cousin ; for no sooner was the little creature put into the tank, than presently the Black Goby caught sight of him, and, rushing towards him, seized him by the tail,

which was in a moment engulfed in the capacious throat. The Blackie glared like a demon as with dilated head he held fast his victim, clutching further and further hold by repeated jerks: the delicate, pel-lucid head of the unfortunate prey, projecting from the cavernous mouth, panted and rolled its eyes in pain, but there was no escape; for now nothing was visible but the head, when the ferocious victor shot under an umbrageous weed, and on my next sight of him all trace of his meal was gone.

The ferocity of this little fish is manifested even towards its own species; one can scarcely come within sight of another without the stronger darting at the weaker, and pursuing him with pertinacity for a considerable distance, following him in all his doublings and shifts, and through all the crevices and passages which he essays in flight, for some time.

The Black Goby habitually loves retirement; lurking under the shelter of the rocks and weeds, yet often coming into view. He proceeds by starts, as if with efforts, shooting a few inches, and resting a while between the strokes, never floating and turning about in the water, like surface-fishes. Near the bottom is his proper sphere; he never comes near the surface except when, very hungry and eager, he sees a fragment of food at the top, and shoots up perpendicularly to seize it, turning instantly downward to his depths again.

The colours of this fish are subject to great change, probably connected with the passions. When it seizes its food, especially if it is a living prey, the general hue is a dull bluish black, nearly uniform, but

occasionally varied with slight cloudings of a deeper tint of the same colour. At other times, when lying still, the body is of a pale pellucid brown, with drab clouds, and patches of white specks. The first dorsal is always of an orange-fawn colour. The eyes are striking, being of a pale blue, exactly like two turquoises.

It is a characteristic of the fishes of this genus that the ventral fins are soldered together, as it were, by their inner edges, so as to form an oval disk. The object of this is the adhesion of the body by means of a vacuum. Colonel Montagu, indeed, says of this species,—“In no instance have we observed that they adhered either to rocks or to the bottom of the glass vessel in which they have been kept alive for several days.”* But I have seen the Black Goby adhering to the glass sides of my Aquarium by its ventral sucker repeatedly, though not until it had become familiarized to its home by several weeks’ captivity.

THE GREY MULLET.

Some half-dozen Mullet-fry, from an inch to an inch and a quarter long, proved very hardy, surviving apparently uninjured, even when the exudations from the putty and paint killed everything else, even the Actiniæ, before the Tank was seasoned. I attribute this immunity to their constant habit of keeping at the surface, where the water becomes perpetually aerated; for they rarely descend far below this, but play day and night at the top of the water. They are social

* MS. quoted in Yarrell's Br. Fishes, i. 283.

little fishes, congregating together into a little schull as soon as put in, and always manifesting a tendency to association. They were amusing, from their liveliness, being never at rest, but ever swimming waywardly to and fro, most vivaciously ; and from the eagerness with which they fed. Any minute atoms of food, either vegetable or animal, they greedily devoured. A bit of apple or pear-pulp, or of a ripe plum, or crumb of bread, slightly chewed and spat into the water, became the centre of rapid evolutions, the result of which was that every atom was cleared away before it had descended many inches below the surface. A morsel of meat, or of fish, cooked, or the flesh of prawn, treated in the same way, was devoured with the same eagerness ; but perhaps the favourite food was the spawn of a Prawn, or Shrimp, either cooked or raw, every egg of which was snapped up as it sank.

They were rather pugnacious, chasing each other about, when one was more successful than usual, just as chickens do, and often snatching the food from each other's mouth.

When, through a predominance of animal life over the vegetable, or from any other cause, the water in the Tank has become to a considerable extent deprived of its oxygen, I have noticed that the little Mullets endeavour to supply the deficiency by protruding their mouths from the surface and sucking in mouthfuls of air, presently disgorging a number of minute bubbles, generally from the mouth, but occasionally through the gill-aperture. That animals of aquatic respiration are able for a time to oxygenate their

venous blood from air alone is proved by the fact that many Fishes, Mollusks, and Zoophytes are able to survive for a long time a privation of water, provided their respiratory organs be exposed to the atmosphere, and be preserved from becoming dry ; while immersion in water from which the oxygen has been exhausted would presently prove fatal.

These little fishes afford another example of the power of mental emotions in changing colours. When pursued and caught with a net, in order to transfer them from one vessel to another, they become of pale semi-pellucid drab hue, on the back, with three reddish lines. But after they have been put in, they gradually resume their original colour, appearing in a few minutes of a dark iron grey. Doubtless fear produces this change, as it does in some of the Reptiles—the Gecko, for example, as I know from observation.

THE ANCIENT WRASSE.

Among the fishes which are now brought to market, the Wrasses are conspicuous for the splendour of their colouring. They have put on their summer attire ;—I know not whether, like our humble country belles, they choose Whitsunday as the day of their first appearance in holiday hues, but it was just about that time that the magnificent Ancient Wrasse (*Labrus maculatus*) first fell under my notice, and since that time the species has become increasingly common.

The fishermen call this, as well as other species of

the same genus, by the name of Conner. They take it chiefly with hook and line on rocky ground ; and as the hook often catches the fish by its thick fleshy lips, no material injury is suffered by it. Hence I get specimens of remarkable beauty brought to me alive and in health, notwithstanding the small dimensions of the vessel in which they are held, perhaps a slop-basin, or some three or four in a little mess-kid, barely wide enough to allow them to turn. But this genus is very hardy, and one of the most easily kept in an Aquarium ; a fortunate circumstance, seeing that the splendour of several of our species is such as can scarcely be exceeded by the most richly-tinted denizens of the tropical seas.

Great variety in the hues, and in their arrangement or pattern, is displayed by the Ancient Wrasse. Two specimens can scarcely be found exactly alike. Red and green are the ordinary hues, sometimes pretty equally balanced, at others the one hue predominating almost to the exclusion of the other. The colours, too, run through various gradations ; the red from orange to scarlet, blood-red, and crimson ; the green from blue to sea-green, grass-green, olive and brown. One of the most beautiful varieties that I have seen, and one not uncommon, is that in which the green is almost obliterated, appearing only on the head and shoulders ; while the body, brown above, softening to silver-white on the sides and belly, is covered by a net-work pattern of deep vermillion, the meshes being irregular, but massive, and most rich in effect. The fins are often orange, with bands or spots of transparent green.

The Frontispiece to this volume represents such a specimen, a little less than the natural size. The fish attains, indeed, much greater dimensions, but the most brilliantly coloured individuals are usually about six inches in length. I have represented it as lurking under a projecting ledge of rock, a situation it loves to haunt, under the shadow of the branching tufts of sea-weeds, from which it picks its insect food. The Sea-weeds introduced into the picture are as follow :—immediately in front of the fish is a plant of *Chondrus crispus*; below its breast is the woolly green *Cladophora uncialis*, a little species remarkable for its compactness, and for the abrupt termination of its tufts. Towards the left are seen two or three fronds of the curious and elegant Peacock's Tail (*Padina pavonia*), of which I have something to say presently; while springing from the same point, and arching over the back of the fish, is a single leaf, —almost as thin and pellucid as tissue-paper,—of *Punctaria latifolia*.

THE CORKWING.

The most common of all our Wrasses is the little Corkwing (*Crenilabrus Cornubicus*). It is less pretentious than some of its fellows; yet bright-coloured specimens are very pretty, and their minuteness, hardiness, and lively manners make them very desirable tenants of an Aquarium. The common dimensions are about two inches in length, but specimens are not rare of twice that size. The colour is green, more or less brilliant; large and well-coloured individuals may be confounded with the Green Wrasse (*Labrus Dono-*

vani), which is also not rare with us; but the little Corkwing may be distinguished by having the fore gill-plate minutely toothed along its free edge, and by a black spot on each side of the tail, just before the commencement of the tail-fin. Mr. Yarrell speaks of the Green Wrasse as if it were a great rarity: but I have had many specimens, some of which agreed accurately with Donovan's beautiful figure. It attains six or seven inches in length. To both species Ovid's descriptive line will apply:—

“*Tum viridis squamis, parvo Saxatilis ore:*”

for all the Wrasses have the mouth small, though the lips are thick; and all may be designated by the term *Saxatilis*, or *Rock-fish*.

The little Corkwing frequents the fissures in the rocky ledges, and is abundant all along the quays within the harbour, hiding beneath the hanging fringe of *Fuci*, that grows between tide-marks. The prawn-catchers take them abundantly with their dip-nets, when raking these sea-weeds; in company with the Fifteen-spined Stickle-back (*Gasterosteus spinachia*), and other small harbour-fishes.

A Corkwing about two inches long, more than usually pretty, being of a bright green hue, with the caudal spot distinct and black, was a tenant of the Tank from the first. He was a fish of business: never for a moment did he swim about as if at leisure, but incessantly pursued one occupation, that of searching the sea-weeds for minute animals. It was pleasant to see with what diligence and sobriety—for he was never eager or in a hurry—he pried into all the recesses

of the leafy weeds, especially the bushy *Chondrus*, taking all positions and attitudes in order to scrutinise the inmost corners ; and with encouraging success, for he was continually picking off something, invisible indeed to my eye, but eaten with evident gusto, to judge by the smacking of his lips. I suppose these were chiefly *Entomostraca*, or perhaps *Infusoria*, which the globular crystalline lens of his eye magnified at the short distance at which he saw them. This distance, which was commonly about half-an-inch, was made sufficiently manifest, by the action of the fish, for the snap was made doubtless the moment the prey was seen. I never once saw the Corkwing attempt to take or even notice any floating atoms of food, but only such as was attached, either to the Algae or to stones.*

This pretty little fish came to an untimely end in a singular way. A large specimen of the Parasitic Actinia was in the Tank, a species which shoots out its thread-bearing filaments in unusual abundance and to great length, when alarmed. I suppose the Corkwing must have accidentally touched the Zoophyte in passing, but this I did not see. On looking at the Aquarium, I saw the little fish with one of the filaments sticking to its mouth, evidently the accident of that very instant. It was greatly distressed ; darted hither and thither wildly as if in agony ; soon lay down on its side, and though two or three times it started up and essayed to swim, it was presently dead.

* Since then, however, I have had a Corkwing, which snapped up readily atoms of cooked meat, thrown in by hand. (*Second Edition.*)

PIPEFISHES.

The Pipefishes are rather uninteresting tenants of an Aquarium; their fins are small and of little power: hence their motions are ordinarily slow. They hang about in all attitudes, of which the perpendicular, either with the head upward or downward, is a favourite one. I have a very young specimen of the Great Pipe (*Syngnathus acus*), a half grown Deep-nose (*S. typhle*), and a rather large \ae quoreal (*S. aequoreus*), about fifteen inches long. This last is slow and unwieldy, possessing no fin but the dorsal; while the former two have tiny pectorals which are fluttered with a rapid vibration, and a small fan-like caudal. All the species flutter the delicate and filmy dorsal fin, at intervals, though but little effect can be produced by such an organ in locomotion.

THE TWO-SPOTTED SUCKER.

The dredge frequently brings up specimens of a pretty little fish adhering to the interior of old bivalve shells, or to stones. It is the Two-spotted Sucker (*Lepidogaster bimaculatus*), which owes its generic name to the circumstance of the ventral fins being united into a concave disk, by the application of which to any smooth surface, and the muscular withdrawal of the central parts, producing a vacuum, the animal adheres with considerable force; exactly on the principle of those suckers that children make of a piece of wetted leather at the end of a string. The little fish is not more than two inches long, somewhat tadpole-shaped, but prettily coloured of a pale crimson or

carnation, with an oval eye-like spot on each side, of a deep red hue.

When put into a vessel of water (no easy matter without injuring it, as it adheres so firmly to its hold), it immediately clings to the side of its new habitation, or to the first solid substance with which it comes into contact. Here it will probably remain for a considerable time, unmoved, or now and then shift its position a few inches, or take a wayward start, and wriggle along with an awkward sort of agility to some other part of the Aquarium, to which it sticks fast in a moment as before. During the night it is much more restless ; but, so far as I am aware, it has no power of hovering in the water, or swimming deliberately to and fro as other fishes do, its locomotive powers consisting only of the ability to shift from one stationary position to another.

As it thus has no power of pursuing prey, I conjecture that its subsistence is derived from those microscopic organisms which are scattered abundantly through the water, and which furnish support to multitudes of other creatures more strictly immovable. In the case of these, which are for the most part invertebrate, strongly ciliated surfaces are provided, which produce constant and forcible currents, and thus the floating atoms in the surrounding fluid are carried along to the orifice of the digestive canal. Our little Sucking-fish has no external apparatus of cilia, that I am cognisant of, but a similar effect is produced in another way. I have noticed that while this little fish remains stationary, being fast moored by its breast-anchor, it maintains a constant and

regular fanning with its filmy pectoral fins. This habit seemed to me at first useless and unaccountable, but on consideration I have little doubt that its purpose is to produce a more free and rapid change of the surrounding water; and that it is one of those compensatory actions that we frequently meet with in physiology, and that are so interesting.

In the tropical seas I have had many occasions of witnessing the actions of a still more singular Sucking-fish, the *Echeneis*. The notion put forth in books, that this fish, being a very slow swimmer, needs to be carried along by others, is simply absurd, and must have been formed by those who never saw the fish alive. It is in no wise inferior, in swiftness or power, to fishes of the same size with which it associates; the Sharks, for instance, to which it so commonly affixes itself. The *Echeneis* bears a very close resemblance, when seen in the water, to a young Shark. It is fond of attaching itself to a grown Shark, usually choosing a spot just behind the pectoral fin, but it as commonly adheres to the rudder or to the bottom of a ship. I have thought that the singular habit may be connected with its manner of taking food; especially as the mouth, owing to the projection of the lower jaw, opens on the upper side of the muzzle. Now when the coronal disk is affixed to any foreign body, the lips are made to touch the latter also. We know that there are multitudes of minute animals, such as Crustacea, Cirripedia, &c., that live parasitically on the bodies of marine animals, and on foreign objects habitually submerged. If the *Echeneis* feeds on these, there is

an obvious reason why the head should be affixed to the surface during the dislodgement of the adhering prey, in order to acquire greater steadiness, as well as a leverage by which to act more effectively. What confirms this view, is, that though the fish may continue to be seen, say on the ship's rudder, for hours, *it is not continually adhering*; but ever and anon shifts its position, detaching itself for a moment, and then adhering again instantly.

Several times lately I have had brought up in the dredge, old valves of the Cockle, Scallop and Oyster, the concave surfaces of which were partly covered with considerable patches of what looked like amber-coloured beads,—such as are used to make bead-purses,—set as close as they could lie, but only in a single layer. They adhere quite firmly to the shell; and I knew that they were the spawn of some fish or crustacean, but was at a loss to know what. On one occasion, in the middle of the summer, I found the little fry escaping, so that the glass vase into which I had dropped the valve was presently quite peopled with tiny fry; their gelatinous hyaline bodies barely visible, and their presence only indicated by the pair of lustrous, green goggle-eyes, which with the intervening head constituted by far the greatest portion of each little creature.

From that charming work "Excursions to Arran," by the Rev. D. Landsborough, D.D., I learn that this spawn was laid by the little Two-spotted Sucker.

DOUBLE VISION.

There is a phenomenon which has long been noticed in that singular reptile the Chameleon, and long supposed to be quite anomalous. It is that the eyes, which in most vertebrate animals move only in unison with each other, and as if by a common impulse, are here quite independent; the one glancing hither and thither, while its fellow remains motionless, or looks in different directions.

A few years ago Mr. Lukis of Guernsey observed that the same peculiarity existed in the Sea-horse (*Hippocampus*), a curious little fish of the *Syngnathidae* or Pipefish family. In my "Devonshire Coast" I mentioned the Worm Pipefish (*Syngnathus lumbri-ciformis*) as a second example of the phenomenon in this class of animals; but I have since found that it is by no means so rare as it had been supposed. All the Pipefishes display it; the Suckers (*Lepidogaster*), tiny fishes of low organization, manifest it strongly: in the Little Weaver (*Trachinus vipera*) I have remarked it very distinctly, and with more than common admiration, on account of the unusual beauty of the eyes in this species, which resemble turquoises set in gold.

The Wrasses (*Labridæ*) have the power of separate motion, but in a less degree: in the Butterfly Blenny (*Blennius ocellaris*) and the Gattoruginous Blenny (*B. gattorugine*) it is more or less distinct, in the former more than the latter. The fishes just mentioned (the Blennies and the Wrasses) have the faculty of moving the two eyes in unison *as well as independently*, apparently at pleasure.

These are all the species* in which I have noticed the phenomenon of separate eye-movement, but I suspect it will be found to prevail extensively among fishes. It is a subject worthy of investigation by the comparative anatomist. The effect to the beholder, if he is in a position to see both the eyes of the animal at a glance, is highly singular and interesting.

THE HONEYCOMB CORAL.

A person who has never seen it before cannot but be struck with the appearance of a large leafy Coral (*Eschara foliacea*), which grows in the form of broad but thin plates, twisted and involved in irregular folds, and sending off other plates at right angles, so as to constitute a sort of honeycombed structure, rising to the height of five or six inches, and covering a space even much greater than its height. Its colour when recent is a fine light red or brownish orange, and its aspect is so noble that one is tempted to think it rather a production of the tropical seas than a native of our northern clime. It is always a welcome guest, not only for its intrinsic merits,—yet it is a charming object in the Aquarium,—but also because of the variety of animals which make their abode in its ample winding chambers. The Prickly Scallop (*Pecten varius*) is frequently found in it; it is usually crowded with the little Masked Broad-claws (*Porcellana longicornis*), which play at bo-peep in the galleries; the deep-water variety of *Actinia clavata*, and

* I have since observed it in the Gunnel (*Muraenoides guttata*). (Second Edition.)

A. bellis, occasionally occupy a chamber, and divers kinds of Nereidous worms crawl freely through it. A beautiful specimen is now in my Tank, which has grown like a noble crown around the summit of a conical stone, the whole being nine or ten inches in height. The basal stone is densely covered with parasitic Zoophytes, and tubicolous Annelides of many species.

But our admiration of this handsome Coral is much heightened when we know something of its nature. We see that its walls, which are not more than one thirtieth of an inch in thickness, are composed of stony substance, yet very brittle. Closer examination shows that this thickness, small as it is, includes two ranges of cells, which are placed back to back, opening by oval orifices on both sides of the walls.

Every cell is inhabited (or rather *has been*, for the older ones are dead and vacant before the younger are formed) by an active Polype of the Polyzoan Class, whose head, crowned with a funnel of radiating ciliated tentacles, protrudes from the orifice or is withdrawn into it at pleasure. These all are united by a common life; a common bond of sensation and of nutrition connects the whole of the individuals into one compound being. A single Polype, inhabiting a solitary cell, began the colony, which has grown by the continual formation of new individuals on every side, as buds grow into branches, which bud again and form a tree.

Some idea of the populousness of such a community may be gathered from the following calculations.

I took a piece from my specimen, on which I carefully marked out an area of one-eighth of an inch square. Within this I found the orifices of 45 cells ; as the rows are double, this would give 90 cells in every square eighth-of-an-inch ; or 5,760 cells in a square inch. Now, in a moderate-sized specimen of the *Eschara*, such as several that I have had in my possession, there are at least 100 square inches of wall, including all the convolutions, and all the partitions, which would give a population of 576,000 inhabitants ; so that a well-grown mass of this coral may bear rank, for multitude, with Vienna, Paris, or perhaps London itself.

Montgomery's exquisite description of the labours of the Coral-worms are scarcely less applicable to the architects of our humble *Eschara* than to those which rear the colossal reefs and isles of the Pacific. Familiar as the lines are, I must quote them.

" Millions on millions thus, from age to age,
With simplest skill, and toil unwearable,
No moment and no movement unimproved,
Laid line on line, on terrace terrace spread,
To swell the heightening, brightening, gradual mound,
By marvellous structure climbing tow'rds the day.
Each wrought alone, yet all together wrought ;—
Unconscious, not unworthy instruments,
By which a hand invisible was rearing
A new creation in the secret deep.
 I saw the living pile ascend,
The mausoleum of its architects,
Still dying upwards as their labours closed :
Slime the material, but the slime was turn'd
To adamant, by their petrific touch :
Frail were their frames, ephemeral their lives,
Their masonry imperishable. All

Life's needful functions, food, exertion, rest,
By nice economy of Providence,
Were overruled to carry on the process,
Which out of water brought forth solid rock."

PELICAN ISLAND.

It is a beautiful thought, by whom originated I know not, that all earthly things are types of the heavenlies ; the visible, shadows and outlines of the invisible. Specimens of this sort of representation are presented to us with considerable copiousness in the Holy Scripture, where ideas of heavenly and unseen things are reflected, as it were, from the familiar objects around us. And this is the only way in which they could be communicable, without a direct and miraculous change in the constitution of our minds. Perhaps it is not too much to presume that the order and fashion of material things were planned expressly with this end in view ; that the characteristics of the *lamb* were given it to make it fitly shadow forth the spotlessness and unresisting meekness of our great atoning Sacrifice, and the essential qualities of *light* were prescribed not only (perhaps not principally) to make it a medium of conveying intelligence through our eyes of worldly things, but that it might represent the glory, purity, truth and omniscience of God, "in whom is no darkness at all."

It is true, that as yet we get but occasional glimpses of these revelations : it is only now and then that a homely object becomes a picture of something higher —a dissolving view, that, while we gaze, changes its lineaments into something of higher beauty and deeper interest, a transparency lighted up in every feature by a glory behind it. "Now we see through

a glass, darkly." But hereafter much may be plain and patent, that now we only guess at ; and the curtain may be broadly lifted that now hangs thick and close over Creation, permitting but occasional rays to struggle beneath its fringes.

Little, indeed, my dull eyes can see of heavenly teachings in earthly things ; but there is one resemblance to a high and holy mystery that I have delighted to trace in one of the lowliest forms of sentient being.

There is a City hidden in heaven, but destined, by and by, to come down to earth ; it rises street above street, and wall above wall, and battlement above battlement; its streets are of gold transparent as glass, its gates are of pearl, and its foundations and walls of crystal are garnished with precious stones. It is peopled by happy spirits in resurrection bodies, by star-crowned men who have washed their robes and made them white in the Blood of the Lamb,—*by none else*. Nay, the City is *composed of these*; it is made of *living stones*, built up one by one in slow and gradual progress, each with an individual consciousness, an individual life.

But (here is the mystery) the City is an individual being; it is a Bride, a Wife. It is the Church of the living God, the Bride of Christ, the Lamb's Wife. One life runs through the whole body, the life of Christ, communicated in resurrection power and perpetuity to her. He bought her,—a pearl of great price,—with all that He had; He nourishes and cherishes her, and He will soon raise her to share his throne.

Is it fanciful to discern a faint shadow of these glories in a poor Polype? If it is, bear with the fancy, for it is not lost time to turn our thoughts heavenward for a moment, whatever be the occasion. When I look on the multitudes of Polypes inhabiting such a structure as I have alluded to, each bearing his starry crown, and all engaged in harmony, building up, wall by wall and cell by cell, an edifice whose walls are of crystalline clearness, often studded with what look like gems,* and whose cells are closed with pearly doors;† when I watch the building growing up into a City, a commonwealth, of myriad individuals; when I know that, besides the separate life of each, there is a common life, a bond of identity, that constitutes the vast assemblage but one Being—One though Many—I cannot help thinking of the heavenly City, the Jerusalem which is above.

* As in *Membranipora*, and *Crisia*, for instance.

† As in *Cellularia*.

CHAPTER VI.

What more felicity can fall to creature
Than to enjoy delight with liberty ?

SPENSER.

A WALK THROUGH PORTLAND.

SOME jottings of the amenities of Portland, which I hastily put down in the course of a pedestrian excursion through it, may not be unacceptable to such of my readers as have not had an opportunity of becoming acquainted with it ; for it is rather an *original* little isle, and has some claims of its own to attention.

After clearing that city of stone blocks which I have before mentioned, I wound round the foot of the hill, and mounted the steep village of Fortune's Well, with its pretty houses and nice shops, all of stone of course (on the principle of patronising the home manufacture), and the substantial church, and neat rectory, where dwells—a blessing to the inhabitants—my venerated friend, the Rev. Mr. Jenour. As I toiled up the precipitous road in the summer's sun, it was a relief to turn, at times, and solace my eyes with the almost boundless prospect that expanded behind, everywhere indeed, except just in front. The villages of Fortune's Well and Chesil, united into one, lie just beneath ; then stretches away in a line, of which the eye fails to detect the termination, the Chesil Beach

dividing two waters, both beautiful ; the one undulating with the long swells of the Atlantic, the other smooth, or at most but rippled. Wyke crowns the hill just opposite with its tall tower and the hedge-rowed fields chequering the slopes around, and beyond it sweeps a long blue line of coast with dim headlands here and there, as far as Torquay.

I passed the Quarries rapidly, for I wished to get to the southern end of the island by low water, desiring, as the time was favourable, to explore the rocky caves and coves that indent the precipitous coast ;—and posted on through two other villages, Highstone and Wakeham, which, like the former two, merge into one. I met here with a garrulous old man, a characteristic specimen of the island population. Like nine-tenths of his fellows, he had united the trades of smuggler and stone-cutter ; he gave me some graphic anecdotes of the adventures of his younger days, when “running tubs,” and described the sad fate of his hopeful son, a stone-hewer like himself, who was suddenly snatched from his side by a block of stone falling upon him, from the seaward cliff where they were quarrying. “The stone split my poor boy right open,” said the old man ; and pathetically added, “I’ve never worked a stroke since ! ”

Few specimens of vegetation can Portland produce that attain the dimensions of a tree ; but near the middle there is a pretty grove of horse-chestnut, maple, elm, and other trees, of no great altitude certainly, but imparting a rural aspect to the vicinity of Pennsylvania Castle, the quondam seat of the governor of the island. Beside this a narrow road scarped

out of the rock brings the traveller to a far more ancient structure, which tradition assigns to

“—That red king who, while of old
Through Bolderwood the chase he led,
By his loved huntsman's arrow bled.”

It is named indifferently Rufus Castle or Bow-and-arrow Castle, from the square loop-holes with which its solid walls are pierced. A single square tower remains, on the summit of an almost isolated mass of rock scarcely more than commensurate with itself, along which the road winds forty feet deep, through the arch of a bridge, which leads to the castle-door from the adjacent heights.

A most magnificent prospect expands as we pass under this bridge. We are on the verge of a precipice, with a little cove below, called Church Hope, the only landing for a boat along this coast. Broken masses of stone are heaped in the wildest confusion on every side, and all up the craggy slopes—a wilderness of grey stone, of which the aspect is painfully desolate, and, so to speak, ruined. A steep and difficult road has been cut down to the beach, and about half-down is a hollow, whither the inhabitants resort for water. Beneath a stone a stop-cock is inserted, that none may be wasted of a fluid so precious: a woman with her pails coming down informed me that every drop they drink has to be fetched in this laborious manner, and carried up the steep precipice. To make it worse, the spring fails in droughts, when they must resort still lower, to a little stream that breaks out of the cliff below.

A little way beyond Church Hope, going southward, there is a vast chasm, produced by some convulsion of nature prior to all tradition. Its general course is straight, and parallel with the coast; running perhaps a quarter of a mile in length, and thirty yards in average width (I speak conjecturally, for I had no means of measuring it); the stone sides rising perpendicularly, exactly like walls, with the stratification imitating courses of regular masonry, but of cyclopean dimensions. Long brambles, shooting from the fissures, spread in patches, which assist the glossy ivy to throw a graceful drapery over the walls of this yawning gulf; and the suspicious blackbird that shot out of her nest at my approach, and the lesser birds that hopped about, showed that, however awful the scene appeared to me, it was not without its charms for these gentle denizens.

I was struck with the resemblance which this phenomenon bears to a chasm in Lundy that I have elsewhere described. No doubt in each case the effect was produced by the partial separation and recession of a *slice* (if I may use so undignified a term) of the precipice, which, instead of proceeding to a fall, which would simply have opened a new line of the coast-edge, became, from some hindering cause, prematurely arrested midway, and has remained so fixed. This is not the only instance which I remarked of parallelism to Lundy in phenomena; though the geological formation of that rocky islet is very different, being granite.

At length I approached the southern extremity of the isle, passing through another village called South-

well, or, as it is pronounced, "Suthill," and coming into sight of the two white lighthouses that are erected above the Bill. It is remarkable how generally the names of the hamlets contain the word "well," showing doubtless that the existence of a spring of water was the determining cause of the position of a village. Here I turned off to the left, deferring to another occasion a sight of the extreme point or Bill, for lack of time, as I was desirous of exploring another singular natural curiosity, Keeve's Hole. Over a breadth of ploughed land, sown with clover in strips, I made my way towards the edge of the cliff; but before reaching it came suddenly on an oval pit about eighteen yards long by eleven wide, and ten feet deep in the middle, where the flat bed of stone is uncovered. The central part of this bed has dropped away; and through the aperture, the thickness of the stratum being about three feet, I looked down into an ample cavern. The interior was somewhat dark, but sufficient light was admitted to allow of the sides and bottom being obscurely discerned; a light which came not from the orifice in the roof through which I was peering, but from a gallery which, with some windings, opened on the face of the cliff, and through which the waves of the sea were dashing with a reverberating roar. I could scarcely look down into the abyss without a shuddering dread, which was not diminished by the story told me by a lad near, of a foolhardy fellow who, to elicit the admiration of his comrades, must needs jump across the chasm. He failed to make good his footing, and fell through into the cavern, which, as well as I could judge, is about fifty feet deep.

Strange to say, he was not killed, nor materially hurt; and his companions having procured ropes from the neighbouring lighthouse, got him out, frightened, and, it may be charitably hoped, somewhat instructed by the adventure. Whether the name of Keefe's, Keeve's or Cave's Hole, as it is variously written, was derived from this involuntary explorer, I could not learn.

The sea-cliffs all about this part are highly picturesque and romantic. The strata of stone are quite horizontal, resembling courses of masonry; and the action of the waves and weather in the lapse of ages has worn away the softer portions, producing a succession of caverns, supported by uncouth pillars, with projecting groins and buttresses. Sometimes these caves run into the solid land; at others they open out again upon the sea at a little distance, making long corridors, or short series of arched vaults, and occasionally, as in the example of Keeve's Hole just described, the yielding of the roof makes a skylight in the interior; so that the various effects of the light struggling with the gloom in these caves are the most picturesque imaginable.

The sense of grandeur too is greatly augmented by the perpetual moaning and roaring of the sea, which breaks upon the foot of the rocks, and as it rolls inward reverberates from the interior;—a sound indefinitely prolonged along the sinuous coast.

*“κῦμα πολυφοίσβοιο θαλάσσης,
Αἰγαλῷ μεγάλῳ βρέμεται, σμαραγεῖ δέ τε πόντος.”*

A slender thread of water falling from the top of

the cliff over the mouth of these cavities, greatly increased the romantic effect; after rainy weather, I can well suppose it a fine columnar cascade, though now it was small.

South of these arches, the cliffs become low and shelving, so that it was not difficult to scramble down to the water-side. The wash of the sea, however, was much too great to make it anything of a collecting ground. Besides the smooth Anemone, a few *Trochus* and *Purpuræ*, a Tansy or two (*Blennius pholis*), and other equally common things, no animal life was visible. Algae were fine, of certain species. *Laminaria digitata* was waving in great magnificence; and that singular plant *Himanthalia lorea*, consisting of long and slender thongs springing from the centre of a flat button: *Chondrus*, *Rhodymenia*, *Ceramium*, and *Polysiphonia*, of common sorts, were all luxuriant in the sheltered nooks between the boulders. I got also some deep-red mossy tufts of the delicate *Callithamnion byssoides*, growing on the stems of other Algae, but on the whole my excursion was fruitless in respect to natural history, though prolific in entertainment.

THE TANSY.

One is apt to slight, as too mean to be worthy of notice, those objects which are very common, though they may possess as many points of intrinsic interest as others, which, because they are more rare, occupy a more prominent place in our regard. I have two or three times passed by the Smooth Blenny, Shanny, or as it is here called, Tansy (*Blennius pholis*), with

somewhat of a contemptuous notice, which really it is not deserving of; for, though it is so abundant in every shallow pool that idle little boys, on Saturday half-holidays, make it the constant object of their sporting excursions, as their metropolitan cousins resort to the suburban canals to catch "Tittle-bats,"—the Tansy is worth putting into an Aquarium. Some specimens are ugly enough, it is true, both in form and colour; but others are quite attractive: they vary much from an uniform blackish olive, to a mixture of bright colours, as green, white and yellow; and the eyes are almost always beautifully brilliant, the large iris being of a vivid scarlet. It is an amusing fish in captivity, displaying a mixture of impudence and timidity, coming out fiercely to snatch a morsel of food from before a fellow fish's mouth, and then darting charily under the shadow of a rock to eat its treacherously gotten booty.

What makes this fish more than usually interesting, is, that it is one of those species which construct an elaborate nest for the deposition of their eggs and the hatching of their young:

"Atque avium dulces nidos imitata sub undis."—OVID.

I have not had the good fortune to meet with the structure myself, and shall therefore refer my readers to the details mentioned by Mr. Couch in his "Illustrations of Instinct" (p. 252 *et seq.*), where the construction of the little dwelling, of fragments of coral-line and other sea-weeds, interwoven by silken threads, its suspension from an overhanging rock, the deposition therein of the amber-coloured eggs, the habits

of the new-born young, the danger they incur from predatory enemies, and the vigilant care of the affectionate parent, are well described.

THE PEACOCK'S TAIL.

One of the most interesting of our native sea-weeds is the Peacock's Tail (*Padina pavonia*). It is so called from its shape, which, springing from a point, expands into a broad fan, with an outline forming, in fine fronds, nearly three-fourths of a circle. A more apt comparison would perhaps be the Turkey's tail, as its form is more closely like, and the concentric bands add to the resemblance. I had been familiar with the plant on the shores of Jamaica, for it is essentially a tropical species, but had never yet seen British specimens in their native haunts : it is marked as rare in our books, and is confined to a few localities on the Channel coast. My friend Mr. Thompson, however, taught me to look for it at Weymouth.

At the foot of the Nothe, bordering its southern side throughout its length, the shore at low-tide runs off in wide flat ledges, the structure of which I have already described. On these, as one dips and another rises, a number of wide shallow pools lie in a sort of chain parallel to the low cliffs. Here I was instructed to watch for the first appearance of the pretty Peacock's Tail.

Unlike most of our *Algæ*, it is an annual plant, to be found only in the summer. The cold of autumn withers its fan-like fronds, and the waves soon wash away all trace of their existence, and it is not until somewhat late in the spring that we detect the

germinating fans of our little friends again. Though I instituted careful examinations of the spots indicated at intervals of two or three days, it was almost the last of May before I could detect the minute thing springing from the mud in the tepid pool. Others, however, soon appeared, and grew fast, so that by the middle of July numerous beds of them were to be found, in which the plants had attained almost their full dimensions, the fronds varying from one to two inches in diameter. Mr. Thompson has endeavoured to propagate this pretty Alga with entire success; collecting the fronds from their native site, when fully ripe, he scattered them in similar situations all along the shore; so that now, under Sandsfoot Castle, and on the ledges between this and Byng Cliff, and in a little bight of the rocks below the Nothe, there are what I may call flourishing gardens of the *Padina*, fully established, and needing no further care for their perpetuity.

It is a curious and interesting Alga, not only for its singular form, but because of its texture, which is delicately membranous; its colour, which is pale whitish olive or drab, marked with numerous concentric bands or zones; its surface, which is covered with a fine whitish deciduous powder, and its circular margin (often split), which is fringed with a line of very minute hairs, set at an angle from the plane of the frond. The sides of the frond frequently curve inward and form scrolls. The specimens will live a good while in the Aquarium; they are somewhat difficult to dislodge in a growing state, owing to the extreme tenuity and tenderness of their point of

attachment, and to the softness of the rock, a sort of indurated clay, on which (at least with us) they generally grow; a substance which often grinds away under the chisel, instead of splitting off.

THE STRAWBERRY CRAB.

Among the multitudes of curious creatures which the dredge rakes up from the prolific bottom of Weymouth Bay there occurs occasionally a pretty little Crab, which is sometimes called the Strawberry, from its being studded all over with pink tubercles on a white ground, remotely resembling the seeds that adhere to the fleshy surface of that delicious fruit. The same peculiarity has been seized to give its scientific appellation, *Eury nome aspera*. These tubercles under a low magnifier are very curious, consisting of short cylindrical columns, the truncate ends of which are beset with polished red or white hemispherical knobs. The first pair of legs have the joints very long, projecting awkwardly in an angle on each side, and the wrists have a curious twist.

Mr. Bell, in his beautiful work on the British Crustacea, calls this one of our rare species, and says that little is known of its habits. I am the more pleased to have an opportunity of adding an item to its history, and of tracing some connexion between its habits and the peculiarities of its conformation.

The story may be summed up in a word; the Strawberry Crab is a *climber*. If it were a terrestrial animal, I should say its habits are *arboreal*. True, it now and then wanders over the bottom of its abode,

with slow and painful march, the hind feet held up at an angle above the level of the back; but generally it seeks an elevated position. We usually see it in the morning perched on the summit of some one of the more bushy weeds in the Aquarium, as the *Chondrus* or *Phyllophora rubens*, where it has taken its station during the night, the season of its chief activity, as of most other Crustacea. It interested me much to see it climb: seizing the twigs above it by stretching out its long arms alternately, it dragged up its body from branch to branch, mounting to the top of the plant deliberately, but with ease. While watching it, I was strongly reminded of the Orang-utan at the Zoological Gardens; the manner in which each of these very dissimilar animals performed the same feat was so closely alike as to create an agreeable feeling of surprise.

This circumstance led me to think of another: the resemblance was not only in habit, but in conformation also; viz. in the great length of arm. This is obviously an adaptation for climbing in the Quadruped as well as the Crustacean; and a few examples occurred to my remembrance in which a similar structure is associated with the like habit. All the Monkey tribe, for instance; and the Sloths of South America, which are almost exclusively arboreal, have the anterior limbs excessively long. Many of the Longicorns among beetles are remarkable for their developed arms, and these are essentially tree-insects. Again, among the Spiders, the perpendicular web-makers—as *Epeira*, *Tetragnatha*, &c., which run to and fro on the tracery of their slender lines, like seamen manning the shrouds

on a fleet gala-day,—have the anterior legs much elongated; while the genera which live on the ground or on fixed objects, as the great hairy Spiders (*Mygale*, *Cteniza*, &c.), the Wolf Spiders (*Lycosa*), and the Jumpers (*Salticus*, &c.), have the legs very short. Perhaps this parallel might be much extended; at the same time I must confess the rule is not without exception; as witness the arboreal Squirrels, whose fore limbs are sufficiently short.

THE CLOAK ANEMONE.

Among the singular disguises by which familiar objects are sometimes rendered difficult of identification, not the least interesting are some that arise from the association of creatures very remote from each other in structure, habit, and zoological position. Many persons who know a Whelk as well as possible, hesitate when they see the familiar shell tenanted, not by the great black-spotted Mollusk, but by a mongrel between Crab and Lobster, with stout, red, pinching claws, and long, jointed, and pointed legs. And still more mysterious does the thing look, when two-thirds of the shell itself are enclosed in a thick mass of purple-spotted flesh, through the midst of which the busy Crab is poking his head and limbs. In truth it is a strange affair, this threefold alliance of Whelk, Hermit-crab, and Cloak-anemone.

Let me describe the last a little more particularly; it is the *Adamsia palliata* of zoologists. All round the mouth of the shell is firmly adhering a soft but firm pulpy mass of flesh, of which the upper part is commonly of a warm brown hue, but the under surface

is delicately white, dotted over with round spots of rosy purple. I have said it adheres *around the shell-mouth*; and this is a curious circumstance, because, as it does not extend *across* the orifice, the animal assumes an annular form, the Crab inhabiting the shell, and protruding freely through the opening. On that side which is next the inner lip or column of the shell, and beneath the breast of the Crab, there opens a wide oblong mouth, in all essential particulars like that of an Actinia, surrounded by a delicate fringe of short white tentacles; which in general are freely exposed, seeking for prey; the animal being little alarmed by the rude treatment to which the peregrinations of its active companion expose it.

This form, at first sight, seems so very anomalous, that a naturalist of no small knowledge has recourse, for its explanation, to the suggestion "that the old shell [of a Gasteropod Mollusk] with a young Crab in it may have been swallowed by the Actinia; that the Crab may have forced its way through the walls of the stomach and the integuments of the latter; and that the Actinia, then secreting a peculiar membrane to defend its base, the Crab may have found itself provided with a habitation suited to its wants." * Yet it appears to me that the deviation from normal structure is more apparent than real. The *Adamsia* is evidently an Actinia of a long-oval form, capable of development in its long diameter into two lengthened wings. Its instinct invariably leads it to select as its support the inner lip of some univalve shell;

* Coldstream, in Johnston's Brit. Zooph. i. 209.

having adhered to which, the lateral expansions creep along the shell, following its surface until they have surrounded the aperture, and meet each other on the *outer* lip. Here the meeting edges unite by mutual adhesion, and seem to grow together; yet the suture is always distinctly visible, both by a slight depression, and by a pale line which assumes a zigzag form, owing to the terminations of the body-striæ fitting into the interspaces of the opposite ones.

What is curious in the case is the instinct which makes the *Adamsia* select a shell as its constant support, and the association with it of a Hermit Crab as the co-tenant of the same shell. This association is, I think, constant; for, though the dredge does occasionally bring up shells invested by the *Adamsia*, which are empty, yet I incline to believe that these shells have been recently vacated by the tenant Crabs, and not that they have never been so occupied at all.

That the above is the correct explanation is evident from specimens in various stages of development. There is in my possession, while writing this note, an *Adamsia*, adhering to a Whelk, of which the lateral lobes, though projected around the edges of the mouth of the shell, have not yet met each other on the outer lip, but are separated by a space of a quarter of an inch. And my friend Mr. Thompson, whose opportunities for studying the marine animals of Dorsetshire have been zealously improved, has just showed me a very young specimen, not larger than a silver threepence, in which the side lobes were not in the least developed. This specimen had selected a land

shell as its support, a not quite adult Garden Snail (*Helix aspersa*), within which a *Pagurus Prideauxii* had taken up his abode also. The *Adamsia* was prettily spotted, though so young ; its position was, as usual, the inner lip of the shell. This curious specimen, interesting on more than one account, was dredged in eight fathoms off Whitenose in Weymouth Bay, a mile or two from land, on the 12th of September, 1853. It lived in captivity five days.

My notion is further confirmed by what takes place in the disease and death of the animal. When the Crab deserts the shell or dies out, the Anemone for a while expands as usual. But, after a week or two, it is evidently seen to be languishing ; and soon its adhering base begins to peel off and shrink away from the shell. Now, this process *commences at the suture*, and as it goes on *the suture divides*, the lateral portions separating more and more from each other, by shrinking ; *reversing exactly the steps by which the annular habit was assumed*, and which I have described above. At length, the connexion of the animal with the shell is wholly dissolved, and the former collapses into a shapeless lump of flesh, from which the integuments slough away in gelatinous shreds, and the whole swiftly becomes a putrescent mass.

Since the above was written, Mr. Thompson has favoured me with an account of an *Adamsia* so aberrant in its habit as to require a modification of the statement that a shell is *always* chosen. My friend writes as follows :—“I have lately obtained a specimen of *Adamsia palliata*, dredged in three fathoms’

water, *on a frond of Fucus serratus*. It is round and united, but with a suture down one side." *

A curious evidence of the efficiency of the thread-capsules as weapons of offence has occurred to me. I was examining the brilliant purple filaments of *Adamsia palliata*, under a power of 200 diameters. There was no pressure applied, but a considerable number of the small capsules were spontaneously dislodged. In the aquatic box which I was using, there was, still affixed to one of the glasses, the sucker of a Gibbous Starlet (*Asterina gibbosa*) that I had just before been looking at. The ciliary action of the Adamsia's filament had been wheeling it round and round, partly in contact with the sucker, and the result was that a good number (a dozen or two at least) of the thread capsules had shot their darts into the sucker, and were seen sticking all around its edge, their threads imbedded into its substance, even up to the very capsules. I thus saw how readily these barbed threads are projected into the flesh of any offending animal; and if they are accompanied, as is probable, by a subtle poisonous fluid, they are doubtless very effective.

The filament under pressure shows thread-capsules in innumerable millions, forming the greatest part of its substance. This immense number is probably intended to meet the continual demand for the use of the weapons during the life of the animal; since, once

* I find that *A. palliata* has the power of shifting its locality like other *Actiniadae*. Two young specimens that I had in an Aquarium, crawled spontaneously from their shells, and attached themselves the one to a stone, the other to a sea-weed frond. (Second Edition.)

shot, the thread sticks in the wounded flesh, and carries the capsule with it; while, if it fail to strike, I suppose it can never be recoiled, and re-inclosed.

The filaments, which are of the same rose-purple hue as the spots, are excessively abundant in this species, and are projected on the slightest disturbance of the animal. The firmness with which they adhere to the fingers, when accidentally touched, so that it is a difficult matter to clear them away, proves that even the most callous parts of the human skin offer no impediment to the entrance of those subtle weapons, the barbed threads, though their poisonous properties are too feeble to be appreciated by our nerves.

THE PARASITIC ANEMONE.

This species (*Actinia parasitica* of Couch) takes rank among the largest of our native Actiniæ, being only exceeded by fine specimens of *A. dianthus*.* It frequently attains a height of four inches, and a diameter of two and a half. It is of a columnar form, nearly equal in diameter throughout, but commonly a little expanded at the base, which slightly spreads over the substances to which it adheres.

The colouring of the body, though subject to some variation, always maintains such an uniformity of style and pattern as to render it easy of identification at all times. Indeed I know of no species which is less liable to be mistaken for any other than this. The ground-colour is a dirty white, or drab, often slightly tinged with pale yellow; longitudinal bands

* *A. crassicornis* occasionally attains a greater size than either.
(Second Edition.)

of dark wood-brown, reddish, or purplish brown, run down the body, sometimes very regularly, and set so closely as to leave the intermediate bands of ground-colour much narrower than themselves: at other times these bands are narrower, more separated, and variously interrupted or broken. I have seen a variety in which the bands took the form of chains of round dark spots, the effect of which was handsome. Immediately round the base the bands usually subdivide, and are varied by a single series of upright oblong spots of rich yellow, which are usually margined with deeper brown than the bands. The whole body is surrounded by close-set faint lines of pale hue, sometimes scarcely distinguishable, except near the summit, where they cut the bands in such a manner as to form, with other similar lines, which there run lengthwise, a reticulated pattern.

Towards the lower part of the body numerous warts appear, mostly minute, but a few among them are large and prominent. The body terminates above in a slightly thickened rim, which is minutely notched, but scarcely rises above the level of the disk, and is obliterated when the tentacles are fully expanded.

The disk is a little wider than the diameter of the body, which it overarches on all sides. Its margin is somewhat thin, and occasionally thrown into puckered folds, to a small extent. Thus it appears to approach the peculiar form of *A. bellis*. The disk is nearly flat or slightly hollowed, but rises in the centre into a stout cone, in the middle of which is the mouth, edged with crenated lips. The tentacles are arranged in seven rows, of which the innermost

contains about 20, the second 24, the third 48, the fourth 96: the other rows are too closely set and too numerous to be distinguished. Probably the whole number of tentacles in a full-grown specimen may be considered as certainly not less than 500. The innermost row springs from the disk about midway between the lips and the margin; they occasionally stand erect, but more frequently arch outwards in elegant curves. When distended with water these are often an inch in length, and $\frac{1}{8}$ th of an inch in thickness; the others diminish in regular gradation until those of the margin do not exceed $\frac{1}{10}$ th in length and a proportionate diameter. All the tentacles are of the same form; though this varies a little in different specimens, sometimes being blunt and nearly cylindrical, at others gradually tapering and drawn out to a fine point. They are pellucid, faintly tinged with flesh-colour, cream-yellow, or purplish, each one being always marked with from one to five pairs of lines or dashes of a dull-purplish colour, running down the two opposite sides to the tip. Those rows which form the marginal fringe are frequently divided into alternate patches of colour, a patch of pale tentacles, then one of purplish, six groups of each colour completing the circle. These alternations do not conceal the lateral marks of the tentacles; and though sometimes beautifully distinct, they are at others scarcely perceptible.

The surface of the disk is pellucid yellowish-white, marked with a circle of six squarish patches of opaque white, corresponding to the lighter portion of the marginal fringe: the lips are also opaque white.

This fine and very distinct species is exceedingly abundant in Weymouth Bay, extending from the deep water of the offing, even into the narrow harbour; but is never met with between tide-marks. It is, as its name imports, parasitic in its habits, though not so strictly but that we frequently find specimens adhering to stones; and in captivity it is by no means uncommon for an individual to detach itself from its native site, and adhere to the bottom of the vessel, or even to crawl a little way up the perpendicular side. Generally, however, it is found embracing some univalve shell, which is tenanted by a Soldier Crab; young specimens on *Turritella terebra*, *Trochus magus*, *T. ziziphinus*, &c.; but adults, which are much more frequently met with than the young, almost invariably on the great Whelk (*Buccinum undatum*). The dredge, indeed, often brings up shells invested by the *Actinia* which are empty; but I believe that in every such case, the shell has recently been vacated by the soldier, and that the *Actinia* never voluntarily selects an empty shell for his base.

The crab who sustains the honourable office of porter to this species is invariably *Pagurus bernhardus*, as *P. Prideauxii* is favoured with the support of *Adamsia palliata*.

In the rude and blundering manner in which the bearer performs his office, it cannot be but that the poor *Actinia* gets many a hard knock, and many a rough squeeze, among the rocks and stones over which his servant travels; but he appears to bear these mischances with great philosophy: I know of no species which lives so constantly expanded. A rude shock

will indeed cause it to withdraw its tentacles, and contract its disk into that button-like shape which is common to the genus ; but this is only for a moment : it instantly expands again, and remains full blown in spite of all its draggings about. Its skin also is peculiarly tough and leathery ; a provision, doubtless, against the accidents to which its vagrant life exposes it.

We have no species which to such an extent as this shoots forth those white filaments, which in this family are weapons of offence. On being alarmed or rudely handled, from several of the warts on the body the animal shoots forth these threads, which exactly resemble white sewing-cotton, to the length of four or even six inches ; and under circumstances of great irritation an immense bundle of such threads is projected from the mouth. These filaments are not wasted : they are shot out in a straight line, but remain attached to the animal, and presently all trace of them has disappeared. *They are withdrawn again into the body.**

This curious result, which I did not anticipate, I proved by carefully watching the process with a lens. The naked eye can readily perceive that each thread is gradually corrugated into small irregular coils at that end which is next the animal, while the free end remains straight. By applying a pocket-lens with a power of 15 diameters to the affixed end, I perceived

* I have since used the presence of this faculty for the purpose of separating such Actiniæ as possess it to form a genus, under the name of *Sagartia*.—See a Memoir on *Peachia hastata*, in the Linnean Transactions for 1855, p. 267. (*Second Edition.*)

that it was sucked in to the wart from which it had proceeded, the orifice of which was clearly visible. Fixing my attention on some part of the thread near the wart, I saw it rapidly approach, and at length disappear within its cavity, and the same process went on constantly, and with all the projected threads together, until all were retracted.

These threads have, I feel assured, no direct connexion with the generative function ; they are weapons of defence, and very effective ones. The fatal effects produced by their adhesive contact upon a little fish I have already described (*vide ante*, p. 108). Their power of adhesion is remarkable, and must have been felt by every one who has handled the species with the fingers ; they cling around the flesh with the most annoying tenacity, so that it is no easy matter to cleanse one's hand of them. In what resides this adhesive power ? Doubtless in the barbed threads which are sheathed in innumerable myriads in every filament. The force with which these javelins are projected, their elastic strength, and their excessive tenuity, enable them to penetrate animal tissues, even of apparently dense texture, and their barbed bristles enable them to maintain a firm hold. On this matter I beg my reader's reference to the note on the filaments of *Adamsia*, in p. 136.

Under the compressorium the thread suddenly cracks, with a start and a crepitation distinctly audible ; a curious circumstance, which seems to indicate a crustaceous or siliceous structure somewhere. I think it cannot be the walls of the filament itself, but the capsules, that crack, minute as they are. The filament



P. R. Gosse, Del't

Hanhart, Chromo, hth

THE PARASITIC ANEMONE &c



is more densely filled with capsules than that of any species which I am acquainted with: perhaps there are even *millions* of them. The capsules are of about the average size of those found in other Actiniæ, viz.; $\frac{1}{875}$ th of an inch in length, and of the ordinary form, linear-oblong, almost straight; the contained thread is propelled to no great length, in some cases scarcely exceeding that of the capsule, in others reaching to five times the length; or from $\frac{1}{700}$ th to $\frac{1}{175}$ th of an inch. A slight thickness is discernible about the basal half, which indicates an armed furniture, but I was unable to resolve its precise structure.

A rank penetrating odour proceeds from this species, in a greater degree than usual. It is communicated to the hands by handling; and repeated washings with soap, and even scrubbings with a brush, scarcely avail to remove it. It is insufferably nauseous.

In the accompanying picture the centre is occupied by this Anemone, seated on the shell of the common Whelk. From the same shell springs a branching zoophyte, *Sertularia abietina*, while a Brittle-star (*Ophiocoma rosula*) is creeping by means of its long snake-like arms over the lower part. Behind the Actinia are seen three or four leaves of that lovely sea-weed, *Delesseria sanguinea*; a tuft of *Callithamnion roseum* springs from a crevice in the rock above the *Sertularia*; a patch of the velvet like *Call. Rothii* is seen on the stone in the foreground, and one of the mossy *C. spongiosum* in the rear. In front of this last are some young leaves of *Rhodymenia palmata*, and a frond of the same species is growing on the shell of the Whelk.

CHAPTER VII.

I saw the peaceful main,
One molten mirror, one illumined plain,
Clear as the blue, sublime, o'erarching sky.
* * * * *

A breeze sprang up, and with careering wing
Play'd like an unseen being on the water.
Slowly from slumber woke th' unwilling main,
Curling and murmuring, till the infant waves
Leap'd on his lap, and laugh'd in air and sunshine.

MONTGOMERY.

A TRIP TO DURDLE-DOOR.

IT was a sweet morning in July, when, intent on a trip down the Bay, we put the dredges on board the boat and made sail. A nice little air from the westward bellied out the red canvas, and we bowled away right before it. The craft in the harbour disappeared ; the houses bordering the wide-spread esplanade grew dimmer and dimmer behind us, till they were no longer distinguishable, and a slender line alone showed where they stood. This line at length faded into the general blue distant haze, that just said a belt of land was there, and that was all.

So memory of past events, as on the rapid wings of time we are ever borne farther and farther from them, towards the ocean of eternity, grows dim behind us. How much more faint I find the remembrance in detail of my summer at Ilfracombe, than it was a few

months ago. My visit to Jamaica becomes every year more filled with hiatuses of recollection, and more and more reduces itself to a general hue; lovely and empurpled, indeed, it will ever be, but one in which it requires more and more effort to trace sequences and to separate adventures; while of early life how large a portion seems (perhaps only *seems*) consigned to absolute oblivion! Yet here and there, along the line of retrospective glance, there are points and prominences which seem as if they could never die—occurrences which are, as it were, burnt-in on the memory, and which the haziness of approximate scenes and incidents serves only to place in bolder relief; just as an increase of distance often makes more conspicuous the mountain peaks which the proximity of a multitude of minor objects concealed or obscured.

Suddenly the wind fails; ruffles up a little, then fails again; another little puff; but all in vain. The sea becomes as smooth as a table, as glassy as a mirror. There is a dancing, glimmering haze all round the horizon, which tells us it is all over with us; and the sun, looking out of a sky unveiled by a cloud, pours down his ire upon our heads in the most ferocious manner possible; and we a couple of leagues from home! I thought of the Ancient Mariner:—

“Down dropp'd the breeze, the sails dropp'd down;
 'Twas sad as sad could be;
And we did speak, only to break
 The silence of the sea.”

Nothing remained but to unstep the mast, and put out the oars. A curious perforated rock was not more

than a mile or two distant, and we resolved to pull in for it, as I had heard of its singular appearance.

On approaching the shore, a natural arch of imposing grandeur met the eye. The lofty cliffs of white chalk are interrupted for a little space by a huge promontory of black rock, cutting across the sandy beach, and projecting southward into the sea. The western angle of the mass sends off a spur which runs parallel with the shore, enclosing a snug little cove ; and in the midst of this wall-like projection yawns a vast orifice, like an enormous arched gateway, leading into the little recess. This perforation is familiarly known as the Barn-door, or Durdle-door, and is one of the appointed places of resort to visitors. I had the advantage of seeing it in that silent solitude which is so congenial to the feelings when in the presence of some stupendous work of Divine power ; no human soul being visible far or near but the old lame and bald-headed shepherd, who had with much difficulty dragged himself down from the elevated downs above, and, having left his crutches on the sandy beach, was enjoying a bathe in the clear water. Even he disappeared, limping up a ravine in the precipice, before I could get ashore.

It was solemn to stand on the angular ledges beneath the arch, and gaze up at its magnificent span. The height of the vault and the depth of the water are sufficient to allow a vessel of considerable size to pass through, at high tide ; but as it was now spring-tide and low water, our little boat could not safely thread the bristling rocks that studded the passage, especially as there was some swell, which, though



DURDLE-DOOR

imperceptible out in the open sea, was heavy enough to bulge in the sides of a boat against these angular points and ribbed groins. We therefore rowed round the end of the wall into the little cove, and, making fast against the rock, stepped out as comfortably as if it had been a quay.

The rocky wall is about sixty yards in height, and nearly twice as long, from the angle of the promontory to its bold and almost perpendicular termination. Along the top, which appears nearly level, and is said to be a yard or two wide, it is possible to walk from the shore, and the view on each side from such a situation must present uncommon grandeur. Patches of samphire, thrift, and other cliff-loving plants, are seen adorning, with verdure and gaiety, the angles and dark fissures of the rock; and various species of sea-fowl,—among which are the guillemot, the auk, the puffin, the shag, and one or two kinds of gulls,—nestle on the shelves and ledges, and heighten by their cries the savage wildness of the scene.

Having satiated to some extent my appetite for the magnificent, I began to peer into the hollows and pools of the exposed rock beneath. From the overshadowing darkness of the place I expected to make a good harvest; but though there were many likely cavities, and a good number of zoophytes and sea-weeds, I found nothing with which I was not familiar before. I therefore set out to walk along the beach, beneath the chalk cliffs, to a somewhat similar projection of black rock, which blocks up the way about a mile off, at a place called Bat's Corner.

The walk was fatiguing; the glare from the per-

pendicular precipice, an unbroken face of white chalk reflecting the rays of a July sun, was most oppressive to the eyes, soon inducing frontal headache ; and the loose shingle alternating with looser sand afforded no firm hold for the sinking and sliding footsteps. My two lads ran before, chasing, with great glee, the young gulls, almost fledged, which had descended in some unintelligible manner, from their nest-ledges up the precipice, but were unable to fly. Cutting off their retreat to the water, the boys chased them till the poor things sought refuge in some corner of the cliff, where of course they were easily caught. They brought home two, nearly grown, which I believe they kept in their gardens for some time. They were probably the Lesser Black-backed Gull (*Larus fuscus*), though, as several species breed about these cliffs, which present little difference in their nesting plumage, I cannot be certain.

A heap of broken rocks, half exposed at lowest water, lies off the corner that terminates the beach. It is known to the fishermen by the name of the Cow and Calf. These rocks I wished to examine for Algæ, and found my search not fruitless. The species were growing from the broken fragments of fallen chalk in considerable abundance, and the specimens were particularly well-grown. Among them a pretty species was common, which I had not observed at Weymouth, —*Chylocladia ovalis*. I have compared the ramuli of *C. articulata* to bladders of red wine, set in chains ; those of the present species are still more like such bladders, being more oval, and set in rows along the branches ; the plant is also taller and more ramified.

But there were indications of a breeze springing up; clouds were forming over the land, and drifting to the southward, and "cats' paws" here and there were ruffling the silvery glaze of the sea into a deep blue. We got on board, and by the time we had pulled out a couple of hundred yards or so, down came a pleasant breeze, cool and fresh, from the north-west. The willing lads quickly stepped the mast, ran up the main-sail and jib, and, giving her a flowing sheet, put her before it; while the water began to ripple off under her quarter, with that rustling sound which a boatman loves to hear.

"——— Τοὶ δ' δτρύνοντος ἄκουσαν,
 'Ιστὸν δ' εἰλάτινον κοίλης ἔντοσθε μεσόδημης
 Στῆσαν δείραντες, κατὰ δὲ προτόνοισιν ἔδησαν,
 'Ελκον δ' ίστια λευκὰ ἔνστρεπτοισι βοεῦσιν.
 'Επρησεν δ' ἀνεμος μέσον ίστιον' ἀμφὶ δε κῦμα
 Στείρη πορφύρεον μεγάλ' ἵαχε, νηὸς ιούσης.
 'Ηδ' ἔθεεν κατὰ κῦμα διαπρήσσοντα κέλευθον."

Od. B. 423.

The dredges were quickly down; and while they were gathering their various contents, I put overboard my Medusa net, to see what the surface might produce on such a sweet summer day. No Medusæ were to be obtained, except one or two small specimens of *Cydippe pomiformis*, a brilliant little sphere of jelly, resembling the clearest glass, rowed along by ciliary paddles, set in eight rows, like the meridians of a globe. But the net came in loaded with tiny active creatures, which I saw, on putting a few of them into a glass phial, to be the young of some Crab in one of the stages of its metamorphosis: not in that earliest state which is called *Zoea*, but that secondary condition known as *Megalopa*. Many of these minute

animals I brought home, and placed in a vase, where they afforded me some entertainment.

These little creatures were about one-fifth of an inch in length ; they had assumed much of the form of a Crab, but the abdomen projected like a long slender tail behind, and was armed at the tip with fine radiating pencils of hairs. The eyes, which were very large, projected on each side, being set on thick footstalks ; and as they were of a brilliant green hue, and very lustrous, they formed a conspicuous feature of the little animals. They manifested a sensibility to light correspondent to this development of the eyes. At night they congregated on that side of their glass prison which was next the candle ; and when I transferred the light to the opposite side, they immediately scuttled across, and crowded up as close to it as possible. They would follow the candle round and round the glass, shifting as it shifted, and stopping when it stopped. They were very nimble in swimming, generally keeping near the surface ; but died off very fast : though the vessel was proportionally large, a few only out of some scores survived the first night. One or two, however, underwent the change into the Crab-form, which I was able to recognise as belonging to the genus *Portunus*.

I took an interesting fish in a somewhat unusual manner. Before the infant breeze had yet broken up the glassy surface of the sea, a small object was seen floating ahead, towards which we pulled. It proved to be a fine specimen of the Sordid Dragonet (*Callionymus dracunculus*) ; a fish which does not usually come to the surface, much less float there. It seemed

stupified, making not the least attempt to escape, as we lifted it with the hand-net, and placed it in a pan of water. There, however, it seemed in no wise injured, but was as lively as so sluggish a fish usually is, playing on the bottom of the vessel. What could have caused it to lie in the burning rays of the sun, on the top of the sea?

The dredges yielded me a fair harvest of zoological varieties :— prettily painted Shrimps (*Crangon*) ; graceful Prawns of the genera *Palæmon*, *Pandalus*, and *Hippolyte*; the Tiny Cockle (*Cardium exiguum*) ; two minute Tops (*Trochus exiguus*, and *T. striatus*) ; the porcelain-like Naticæ (*N. Alderi* and *N. monilifera*), remarkable for the enormous masses of white gelatinous flesh which they protrude when they crawl, investing and almost concealing the shell ; a few Starfishes and Urchins ; plenty of *Ascidiae* and *Botryllidæ* ; various *Annelides* ;— Hermits and Spider-crabs by scores ; several specimens of the beautiful Cloak Anemone (*Adamsia maculata*) ; and a few of that magnificent species, the Plumose Anemone (*Actinia dianthus*), as well as the Parasitic, the Daisy, and the Weymouth Anemones (*A. parasitica*, *bellis*, and *clavata*). Some of these I have already described ; others I shall take occasion to allude to ; I will here content myself with a notice of one of the most gorgeously clad of all the creatures that inhabit the deep,—the Sea-mouse.

It is not in its form that we must look for any peculiar elegance, for it is a flattened worm, of an oval outline bluntly pointed at each end ;—nor in its general colour, for this is that of the pale brown sedi-

ment that water deposits. But it is in the clothing of long silky hair which covers each side, and which reflects the most brilliant and resplendent hues, equaling the splendours of the Humming-birds, or the Diamond beetles. Hence Lamarck gave it the appellation of *Halithea*, or Sea-goddess; and Linnæus before him had conferred on it the name of the goddess of beauty, *Aphrodite*, the Greek title of Venus. The great master of Natural History thus expresses his admiration of this sea-worm: "The *Aphrodite aculeata*, reflecting the sun-beams from the depths of the sea, exhibits as vivid colours as the peacock itself, spreading its jewelled train."

In the Aquarium, the Sea-mouse crawls restlessly to and fro, and round the margin of the bottom; once or twice I have seen it essay to burrow under the fine gravel, but generally it lives exposed. It is uninteresting in its manners, though the brilliance of its changing colours will always attract admiration. Perhaps it is most beautiful by candle-light, when red and orange reflections predominate; by day, pearly greens and blues prevail. This difference is owing to the position of the light, and the angle at which it is reflected. Thus, if the eye glance along the bristles towards the light, which is reflected at an obtuse angle, the reflected rays will be lilac, passing into ultramarine; if the angle of reflection be a right angle, the rays will be green; if the light be between the observer and the animal (not directly but obliquely, so as to make the angle of reflection more or less acute), the reflections will take yellow, orange, scarlet, and crimson hues.

As it crawls, the *Aphrodite* usually elevates the tail, which is so folded together as to form a deep groove beneath. By watching this, we see now and then ejected a stream of water with considerable force. I found that the jet occurred once in twenty-five seconds, with punctual regularity. This is a respiratory act; the grooved orifice through which the jet is poured is not the termination of the intestine, as we may at first suppose, but the exit of a capacious chamber which is external to the body, though concealed.

A very marvellous and quite unparalleled structure here comes into view. If we take a Sea-mouse into our hand, we see the whole breadth of the back occupied by a woolly substance, closely resembling felt, and formed by the interlacing of fine hairs. If we insert a penknife into the tail-groove, and slit up this felt-like cover, we expose an ample cavity running the whole length of the animal, the floor of which is the true skin of the back, on which are set two rows of large overlapping plates, or membranous scales (*elytra*).

The dense tissue of interwoven hair resembling felt acts as a filter for the water to be respired, straining off the earthy particles held in it, which thus accumulate in its substance, and impart that peculiar dirty appearance which it possesses. The scales, according to Dr. Williams,* are periodically elevated and depressed. In the former action, the water permeates the felt, and fills the vacuum formed between them and the back. As soon as it is full, they collapse;

* Report on the British Annelida, 200.

and the filtered fluid, now deprived of its oxygen, is forcibly expelled at the anal groove. Well may the adoring Psalmist include among "the riches" of God, the "things creeping innumerable, both small and great beasts," wherewith "this great and wide sea" is filled ! *

PENNANT'S EBALIA.

A female of this quaint little Crab (*Ebalia Pennantii*) was obtained, the knobbed carapace of which carries a specimen of that curious pellucid Bryozoon, *Alcyonium gelatinosum*. This is a fruit-like body, about an inch in length, nearly cylindrical, with the tip rounded, and the base diminished to a footstalk springing from a minute point. The beautiful bell-like Polypes are projecting by hundreds from every part of the surface, distinctly perceptible even with the naked eye. Though this parasitic appendage springs from the very centre of the tuberculous cross on the back of the Crab, it projects forward over the head, a position which has relation to the burrowing habits of this little Crustacean.

The latter is inert, folding its legs on itself when touched, and remaining motionless for some time. It buries itself in the gravel, descending backwards : this is a somewhat slow process, suited to its usual phlegmatic habit. It brings its hindmost pairs of feet on each side together ; then thrusting down their united points, opens and expands them, forcing apart the gravel : at the same moment the posterior part of the body is brought down into the hollow thus made,

* Psalm civ. 24, 25.

and the action of the feet is repeated. The process is continued until the hinder parts are covered, and the muzzle alone is visible, with the two claws. Thus it sits quite still, reminding one of a toad, the broad triangular pedipalps that fit so close occasionally opening, like the folding-doors of a tiny cabinet, and allowing the palpi to be thrust out, to wipe the minute eyes. The face, when examined with a lens through the glass walls of the Aquarium, has a most funny expression, being singularly like that of an ancient man.

Like many marine animals, the *Ebalia* uses the hours of night as its chief season of activity. As long as the candles are in the room, it remains pretty still, but as soon as darkness reigns it sets out on its travels. Not indeed with the railway pace of some of its fellows, does our little ancient travel ; he is but a "slow coach;" but he gropes about among the pebbles, and is usually found the next morning, buried at some distance from the point where the previous evening had left him. Fortunately his movements are easily traced ; for the tall ventricose parasite which he carries on his back cannot easily be concealed, and this betrays the secret of his hiding-place.

I kept my little prisoner for five or six weeks ; and he might have survived an indefinite time, but for the violence of a powerful neighbour. One morning I saw his shell and limbs broken to fragments, and emptied of all the soft parts. More than suspicion rested on the savage Violet Fiddler (*Portunus puber*), whose biography I shall presently record. The last occasion on which I had seen my little *Ebalia* alive

was two days before, when I had routed him out of his burrow to show him to a visitor.

THE COMMON SOLDIER-CRAB.

The Soldiers (as indeed becomes their profession) are well known to be pugnacious and impudent; yet watchful and cautious. Indeed, their manners and disposition, no less than their appearance, bear the strongest resemblance to those of Spiders, a resemblance not peculiar to this genus, but more or less characteristic of all the Crabs. Two of them can scarcely approach each other without manifestations of hostility; each warily stretches out his long feet and feels the other, just as spiders do, and strives to find an opportunity of seizing his opponent in some tender part with his own strong claws. Generally they are satisfied with the proofs afforded of mutual prowess, and each, finding the other armed at all points, retires; but, not unseldom, a regular passage of arms ensues, the claws are rapidly thrown about, widely gaping and threatening, and the combatants roll over and over in the tussle.

Sometimes, however, the aggressive spirit is more decided, more ferocious, more obstinate. One in the Aquarium of the Zoological Gardens was seen to approach another, who tenanted a shell somewhat larger than his own, and, suddenly seizing his victim's front with his powerful claw, drag him like lightning from his house, into which the aggressor as swiftly inserted his own body, leaving the miserable sufferer struggling in the agonies of death.

The association which often exists between animals of different races and even of different classes, is always a curious phenomenon ; and the motives which impel to the companionship, no less than the mode in which acquaintance is first formed, are most recondite. When this species (*Pagurus bernhardus*) inhabits the shells of the Whelk, it is quite common, though by no means universal, to find the spire of the shell occupied as the seat of that very fine Anemone, *Act. parasitica*, which rears its tall and stout form like a thick pillar, surmounted by its dense fringe of tentacles that wave, brush-like, with every vagrant movement of the Crab.

But I find that this association is not the only one that exists here. While I was feeding one of my Soldiers, by giving him a fragment of cooked meat, which he, having seized it with one claw, had transferred to the foot-jaws, and was munching, I saw protrude from between the body of the Crab and the Whelk-shell the head of a beautiful worm, *Nereis bilineata*, which rapidly glided out round the Crab's left cheek, and, passing between the upper and lower foot-jaws, seized the morsel of food, and, retreating, forcibly dragged it from the Crab's very mouth. I beheld this with amazement, admiring that, though the Crab sought to recover his hold, he manifested not the least sign of anger at the actions of the Worm. I had afterwards many opportunities of seeing this scene enacted over again ; indeed, on every occasion that I fed the Crab and watched its eating, the Worm appeared after a few moments, aware, probably by the vibrations of its huge fellow-tenant's body, that feeding was going on, and not I think by any sense of smell,

for a reason which I shall presently adduce. The mode and the place of the Worm's appearance were the same in every case, and it invariably glided to the Crab's mouth between the two left foot-jaws. I was surprised to observe what a cavern opened beneath the pointed head of the *Nereis* when it seized the morsel, and with what force comparatively large pieces were torn off and swallowed, and how firmly the throat-jaws held the piece when the latter would not yield. Occasionally it was dragged quite away from the Crab's jaws, and quickly carried into the recesses of the shell; sometimes in this case he put in one of his claws and recovered his morsel; at others he gave a sudden start at missing his grasp, which frightened the Worm and made it let go and retreat; but sometimes the latter made good his foray, and enjoyed his plunder in secret.

The Worm is itself a striking and even handsome animal; and there is in its colours and their distribution,—two bright white lines running through the whole length on a light red ground,—a curious similarity to the colouring of the Crab.

I have reason to think that the partnership in question is by no means casual or exceptional, but ordinary, if not constant. A second Whelk-shell in my Aquarium, surmounted also by a Parasitic Actinia, but which has been deserted by the Soldier, retains a *Nereis* as its tenant: and I know from experience, as well as from the report of others, that this showy Worm is usually found a co-occupant with the Soldier of old shells. The fishermen of Weymouth prize this Worm for bait more than any other; and are so well

aware of its habits that they commonly break all Whelks containing Soldiers, in order to extract the *Nereis* which they know is within. Dr. Johnston in his description of *N. bilineata* (Ann. N. H. July, 1839) has alluded to their occurrence together.

Besides the interesting fact of this mutual friendship, we learn somewhat from the above observation of the rapacity and carnivorous habits of the genus *Nereis*, already inferred from their anatomical structure. That the senses of this Worm are not very acute I infer from the following experiment. I dropped a piece of meat into the mouth of the Whelk-shell that was tenanted only by a *Nereis*, and watched the result. After a time the Worm protruded, not apparently induced so to do by any expectation of food, and though its head was often brought almost into contact with the flesh, it was evidently unconscious of the proximity; for it took not the slightest notice of it, and allowed it to remain untouched all day.

The graphic description of the Soldier going about on the beach, turning over and examining shells, and now and then trying how they would fit his body,—has been so often quoted that we are apt to think it is a common sight, and may be witnessed by any stroller on a shelly beach. Yet I think the fact has been very seldom seen; and I judge so from my never having seen any other than the one well-known story, which, if I mistake not, was originally told by old Du Tertre of some American species. I have had the pleasure, however, of confirming its accuracy, at least in some points.

Looking at my Aquarium, I saw that the Soldier was in a different Whelk-shell from his own. Both were surmounted, as I have said before, by the Parasitic Actinia, but a diversity in the colour of the tentacles rendered these distinguishable from each other at a glance. I shall call the Crab's own original Whelk, No. 1, and the other No. 2. My curiosity was excited, of course, and I sat down to watch. The Crab kept fast hold of shell No. 1, by placing his walking feet within its aperture, all the time he was within No. 2. Presently he slipped out his plump posteriors from the new tenement, and in a moment popped back into his old one, which was indeed the larger of the two, and hobbled away.

The next day I saw the attempt renewed, and this time witnessed the procedure *ab initio*. The Soldier on his rambles blundered on a third Whelk-shell invested by the beautiful *Adamsia*, but untenanted. This he seized, rolled over, and turned about in all directions, feeling it in all parts, both within and without. The *Adamsia* he seemed not to like, and tried repeatedly to scrape it off the shell with his pincers, labouring hard at the work, though ineffectually: the rude operation appeared to produce little inconvenience to the soft and delicate, but tough-skinned Anemone, which, withdrawing its tentacles, and contracting its body, offered a passive resistance to the persecutor. At length he was satisfied that the shell was much too small, and, relinquishing it, proceeded on his travels.

Presently he came to shell No. 2, that he had tried in vain yesterday; that essay, however, he had evidently

forgotten, or, at least, he did not recognise the shell; for he immediately began to turn it about, rolling it over and over with his sharp feet, twisting the *Actinia* most awry. He carefully examined the interior, feeling it all over with both claws, and trying every spot as far as he could reach ; this examination he continued for perhaps five minutes, and then, as if satisfied, drew out his feet, and made an essay to quit his own shell. It was apparent that the exposure of his soft person was considered somewhat dangerous, for he first felt with his antennæ in all directions around, vibrating them up and down, and partly coming out and retreating several times before he ventured. At length, however, out he popped, and into the new house as quickly, where he turned and settled himself comfortably. There was not much difference in dimensions between the shells, but, as I have said, what there was, was in favour of his original dwelling.

He remained in his new quarters for ten minutes or more, moving about a little, but never for an instant letting go his old house, on which he pertinaciously kept his feet, occasionally putting in his pincers to feel the interior. At length he decided that, inconvenient as it was, it was better than the new one ; and therefore he returned to it, as he had done the previous day, and relinquished the attempt.

The day following he repeated the same process of temporary exchange, walking about for a considerable time with his new abode, and yet at length resuming the old one.

On a subsequent occasion I saw another individual of the same species, reduced to the condition of a

“ houseless wanderer.” The Whelk-shell which it inhabited had been laid hold of by the sucking-feet of a Sea-Urchin (*Echinus miliaris*), the Soldier having bivouacked in unconscious proximity to this adhesive subject. The rest of the Urchin’s feet were firmly moored to the solid rock; so that when the Crab attempted to walk, he found his home-shell immoveable. What was to be done? He was probably hungry after his repose, and food must be sought. After vainly dragging for a few minutes, he chose the alternative of exposure, let go his posterior hold, slipped from the shell, and wandered naked. Half a day he roamed in this defenceless state, till, meeting with a large Whelk-shell empty, he gladly popped in, and though the tenement was inconveniently ample, kept possession, wisely judging that inconvenience was preferable to danger.

It is a doubtful point whether the Soldier is a murderer and freebooter, like Ahab in Naboth’s vineyard, slaying before he takes possession, whenever he happens to fancy a tenanted shell, or whether he merely makes free with a house that he finds unoccupied. Wishing to settle the point, I procured a living Whelk of about the size to suit the Crab’s necessity, and put it into the tank, when the latter was in the state of uneasiness described above. But, though they were thus thrown into association for several days, the Soldier never made the least assault upon the living Mollusk, nor attempted to take his shell.

After the preceding observations were written, my esteemed relative James A. Salter, Esq., mentioned in conversation that he had witnessed the process of the Soldier’s “moving house.” At my request he has

favoured me with the following particulars, which, while they agree with my own observations in essential points, superadd some interesting details.

" I have many times found Hermit-crabs out of their shells, in the mingled mass of a dredge-haul, and on three occasions have watched the method in which the houseless creature domiciliates himself. These were the only occasions on which I endeavoured to observe the operation : they always seem willing enough to exhibit their housing performance.

" My plan of observation was simply this :—I put a naked Crab into a large glass jar of sea-water, with one shell, the latter of size about proportioned to the former ; and then I contemplated. In each case the Crab proceeded in the same way.

" Appearing to *see* the shell in the distance, the animal crawled up to it for the purpose of seeing if the house were to let ; and this circumstance he discovered not by sight, but *touch*. Upon reaching the shell he hooked two of his legs into its open mouth, and thrusting them as far down into its cavity as possible, commenced scrambling round the edge : he was evidently probing to discover if there were already an inhabitant. In each case the Crab pursued this probing operation in the same direction—commencing on the projecting side of the shell, and ending on the receding side. Having performed this process once round, he instantly, in the twinkling of an eye, erected straight his tail, and whisked himself *over the smooth lip of the shell* into its tube, with a rapid adroitness that was perfectly marvellous. And then in his new contrasted position he looked so funny—such *at-homeishness* there was in

it; he was so different from the poor, houseless vagabond with a drivelling tail, that one had seen miserably crawling about a moment before: he looked right up in your face, and said, as plainly as looks can speak, ‘How d’ye do? here I am, quite at home already.’ I never saw it without laughing.”

THE COMMON PRAWN, AND THE BULLHEAD PRAWN.

The Prawns are particularly pleasing inhabitants of the Aquarium. There is a certain lightness in the slender filiform appendages of the head, which are continually thrown into the most graceful curves, that resembles in character “the light tracery of ropes and spars” so much admired in a trimly rigged ship. Their bodies are so pellucid that a lady who was this moment looking at the Tank compared them to ghosts, and their smooth gliding movements aid the similitude. The beautiful colours which adorn them I have described elsewhere, and shall merely here say that the fine contrasts of the black-margined lines of pale yellow with the pellucid grey of the ground, show well as the animals rest on the dark stones. The two species (*P. serratus* and *P. squilla*) are so closely alike in their colours and in the distribution of these, that it is only by minute examination and comparison that we can determine what is characteristic of each. The most obvious distinction is, that in the former the outer tail-plate has a yellow line, the intermediate one no spot or rarely a minute speck; the middle plate two parallel specks also minute. In *P. squilla* each plate has a roundish or squarish spot of yellow, all

equal in size, and forming an angular band of spots. The distinctions drawn from the form and dentition of the rostrum, and the gibbous carapace of *P. squilla*, I need not speak of particularly, as these are sufficiently appreciable in cabinet specimens.

When viewed with a candle, the eyes of the Prawn reflect the light with a glare exactly like that seen in a cat's eyes under similar circumstances. The light, in the case of the Prawn, is seen only when the candle is held between the beholder and the insect, and becomes brighter and larger the more nearly the flame of the candle is brought to the line which unites the observer's eyes and the object. It might seem as if nothing could possibly be discerned when the flame is absolutely in this line, but it is not so ; both eyes being open, the line of vision of each eye passes on one side of the candle, and we discern the two eyes of the Prawn, like two little globes of fire.

In the case of the cat the phenomenon is said to be produced by the choroid coat at the bottom of the eye (*tapetum lucidum*), reflecting from its polished metal-like surface the entering rays, and converging them by its concavity, as if from a concave mirror. This is simple and perfectly intelligible ; but I do not see how a similar effect is produced in the compound eyes of the Crustacea, each of which is composed of a great number of conical lenses with apices inward. What is there in this structure that can represent a concave mirror ? Yet no one can look at the sight I am speaking of, without feeling certain that the optical process is one of concave reflection and convergence of the rays ; and that the reflecting surface

is in the interior of the globose compound eye. The reflection is seen whatever part of the eye is opposite the light (provided it be faceted, of course), but is most full direct in front, where no unfaceted portion can be seen. Yet it certainly has no connexion whatever with reflection from the *exterior* surface, as might be suggested by any one who has not actually seen it: the effect of this would be a minute point of light, very different from this broad round gleam.

The different species of *Pagurus*, and some Crabs, as *Portunus*, exhibit the same phenomenon, but in a lower degree; the disk of light being smaller and of less brilliance; though their eyes are larger. I have seen the same appearance in the eyes of Moths and other nocturnal insects; so that doubtless it is dependent on the common structure of faceted compound eyes.

It is pretty to see the Prawn fed. When a morsel of food is dropped through the water near its head, the excessively long antennæ (especially the long filaments of the superior pair, which are carried perpendicularly upwards) seem principally to take cognizance of its presence and of its qualities. The eyes, though evidently alert, are, I think, less trusted. As the morsel comes within reach, the second feet, the principal organs of prehension, are stretched out, with the two fingers (pinchers) widely extended; these seize it with the most easy action possible, and in a moment thrust it towards the mouth.

CLEANLINESS.

Many contemplative minds have been exercised on the immense amount of energy and time that are expended in the mere procuring of food and clothing ; and the pious have bowed to the necessity as part of the curse under which the earth still groans on account of sin. “ In the sweat of thy face shalt thou eat bread ” was the righteous sentence on fallen man ; and we know assuredly that if innocence had remained, other clothing would have been unneeded.

But possibly it may not have struck every one that almost as much of time and labour are consumed in cleansing away impurities. Our bodies, our garments, our furniture, our houses, our streets, are perpetually being cleaned : it is clean, clean, clean,—wash, scrub, scour, brush, sweep,—from morning to night, from week to week, from year to year, a constant unremitting war with DIRT ; a war hopeless because endless, a war with an enemy that may be kept in check, but can never be conquered. No sooner by herculean efforts have we made a successful onslaught on the foe, and apparently subdued him so that he cannot show his face again, and begin to sit down in complacency, than lo ! we descry his unsightly sappers and miners retaking all the points we thought we had secured, and we exclaim, in disappointment and despair,—

“ The creature’s at his *dirty work* again ! ”

I incline to think that *this* necessity is as much a judicial sentence as the other ; that it also is part of the curse. It is true we may trace it to the laws of

matter ; to the excretions of living beings, the natural course of decomposition in organic substances, the abrasion of inorganic surfaces by friction, the laws of motion, of gravitation, and the like. I know that all this may be said, and said truly ; and yet I doubt much if this perpetual round of strife with dirt, that makes the poet's lamentable ditty,—

“ There is nae luck aboot the hoose
Upon a washin' day,”—

applicable to all the world, and co-extensive with all time, would have been our lot, if we had maintained a Paradisiacal condition of existence.

Be it so ! judgment in neither case is unmixed with mercy. It is not an *unmitigated* curse under which Creation groans. A Father's hand is manifest in the wisdom and love, which has made the pronounced and inevitable sentence to be a corrective discipline, and not a vindictive punishment. What crimes have been prevented, what proficiency in iniquity cut short by the necessity of labour for the support of life ! And in like manner tens of thousands are daily kept out of idleness, and its concomitant temptations, by the incessant demands of cleanliness upon toil. The condition of existence being what it is, *a fallen condition*, a state in which a proclivity to sin is the universal rule, how merciful is the appointment of a discipline which should directly minister blessing to the mass of mankind in several ways ! Preventively, by limiting our opportunities of evil ; temporally, by giving support, directly or indirectly, to myriads of persons ; and spiritually, by reminding us of an inward uncleanness, which must be effectually

purged away, before we can become inhabitants of that city of light and bliss, into which shall enter “nothing that defileth !”

If this is a correct aspect of the subject, it was natural that the inferior creatures, who fell federally in their lord and head, should share in the consequences of his sad lapse. Hence, we find not only that the procuring of food occupies a large portion of the time and energy of the brute animals, but also that of what remains much is devoted to operations of cleanliness, personal and local. In all probability both of these occupations are to them actually pleasant, instead of burdensome ; their part of the punishment (as I have elsewhere remarked) is, in many respects, indignity rather than suffering, though they have enough of the latter too. Every one has seen how much of her leisure is occupied by a cat in cleansing herself and her offspring ; and the zest with which she goes through her task indicates that it is not unpleasing. Other animals perform analogous operations, varied, however, so much in the details of their purposes, modes, and implements, that I am persuaded an interesting treatise might be written exclusively on animal cleanliness.

I am not going to write such a treatise, but merely to describe an example that I have noticed among the tenants of my Aquarium. I have before said that the second pair of feet are used by the Prawn (*Palæmon*) as his principal organs of prehension ; and this might have been inferred from their superior length and stoutness, particularly the size of the pincers or didactyle hands. On cursory observation you are puzzled

to know what is the use of the slender first pair, which are also furnished with didactyle hands, but very diminutive and feeble. See the Prawn, however, washing himself after dinner, or at any other spare moment, for he is careful to maintain his polished coat of mail most scrupulously clean. You will then see that the front feet are cleansing organs. They are beset with hairs which stand out at right angles to the length of the limb, radiating in all directions, like the bristles of a bottle-brush. You will not see them to advantage, it is true, in dried specimens: but in a living state, or even when preserved in spirits, they are conspicuous enough under a lens. These are the Prawn's washing brushes, especially applied to the cleansing of the under-surface of the thorax and abdomen. When engaged in this operation, the animal commonly throws in the tail under the body, in that manner which we see assumed in the pink specimens that are brought to table, which is not, however, the ordinary posture of life, the body being nearly straight. Then he brings his forefeet to bear on the belly, thrusting the bottle-brushes to and fro, and into every angle and hollow with zealous industry, withdrawing them now and then, and clearing them of dirt by passing them between the foot-jaws. The reason of the inbending of the tail is manifest; the brushes could not else reach the hinder joints of the body, and still less the swimming plates; but by this means every part is brought within easy reach. Sometimes the brushes are inserted between the edge of the carapace and the body, and are thrust to and fro, penetrating to an astonishing distance, as may be

distinctly seen through the transparent integument. Ever and anon the tiny forceps of the hand are employed to seize and pull off any fragment of extraneous matter which clings to the skin too firmly to be removed by brushing; it is plucked off, and thrown away, clear of the body and limbs. The long antennæ and all the other limbs are cleaned by means of the foot-jaws principally.

THE SERPULA.

There is scarcely any object more familiar to the eye of one accustomed to dredge, or to pore about the water's edge at extreme low tide, than the tubes of stony or shelly substance which are found adhering, in various contortions and aggregations, to almost every stationary object that is habitually submersed. The under-sides of every ledge, of every boulder, and almost every pebble, are studded with these twisting, creeping tubes, which seem to contend with the crowding Acorn-barnacles (*Balanus*) for the possession of every inch of space within their domain. Those that occur within tide-marks are usually of a small species, with the tube strongly carinated, and somewhat three-sided, and the exposed part of the animal banded with bluish-grey. But in deep water they are much finer and more brilliantly coloured. I believe the former is *S. triquetra*, the latter *S. contortuplicata*; but the species of this tribe have yet to be disentangled from the confusion of closet nomenclature. It is of the deep-water species that I would speak; not the rarer solitary kind (*S. tubularia*), that adheres to the stone or shell by only a small portion

of its tip, and rears the remainder of its tube in pillar-like erectness to the height of half a foot or more ;*—but of that most abundant one, which every haul of the dredge raises, on old shells, broken pottery, fragments of bottles, &c. grouped in intricately contorted and intertwined masses, which adhere for the greater part of their length, and are free only at or near the anterior extremity.

The tubes of fine specimens are about one-fourth of an inch in diameter, cylindrical, with the mouth slightly expanded. The successive stages of growth may be traced by these expansions, for the addition is evidently made, not from the expanded edge, but from a little way within, so that the general diameter of the tube is preserved, while these trumpet-lips project at irregular distances, in a foliated manner, like the bases of sheathing-leaves. You would probably look with little interest on these clumps of dirty-white, rough tubes, on seeing them come up in the dredge, but in an Aquarium few objects are more attractive. As soon as the tenants of these pipes begin to feel themselves at home, they cautiously protrude. The first thing you see is what looks like a scarlet cork fitted into the mouth of the tube, as if into the neck of a bottle ; by gradual steps, this is pushed a little, and a little, farther out, until at length a brilliant array of fans of the same gorgeous hue protrudes, and expands into a sort of oval funnel, defective at one side, and with the opposite margin bent inward in a sinuous form.

* An error in nomenclature. *Tubularia* is a true *Sabellida*, not a *Serpula*. (*Second Edition.*)

Take your pocket-lens now, and examine the structure of these brilliant organs in detail. *Presto!* on the slightest movement of your hand towards him, he is gone! He has retreated like a lightning flash into his tube. But did you notice how cleverly, as he went, he shut the door after him? A most marvellous contrivance is here. Watch it as it again carefully protrudes. There is a solid organ exactly conical, seated at the end of a long flexible stem, which forms the stopper: it is one of a pair of tentacles; but as only one could be of any service as a stopper, one only is developed; the other being minute. This stopper is very beautiful; it is always richly coloured, usually orange, or vermillion, sometimes varied with pure white: its flat extremity or top is made up of ridges, which run from the centre to the circumference, where they project in tiny teeth of the most exact regularity. The fan-like expansions are formed of radiating filaments, also very brilliant in hue, which are the breathing organs, separating oxygen from the currents of water which play along their ciliated surfaces.

There is no distinct head in these animals, but the organs I have described are protected by a sort of projecting mantle or hood, beneath which is the orifice of the stomach. Eyes it seems to have, and most sharp ones; for, as we saw, the animal is peculiarly sensitive to the approach of any object, even though this be on the outside of a glass tank, at the bottom of whose interior it is expanded. Yet I have searched in vain for any distinct organs of vision.

The mechanism by which the *Serpula* projects its

body from its shelly tube, and by which it withdraws on alarm with such inconceivable rapidity, is wonderfully curious. I will describe each of these in turn. Behind the head (or what for convenience may be so named), the sides of the body are cut into nipple-like feet, about seven pairs in all, which are perforated, and carry so many bundles of fine elastic, horny bristles, like the hairs of a camel's-hair pencil, each pencil carrying from twenty to thirty bristles. By means of suitable muscles, the pencils are pushed out to their full length, or withdrawn so as to be wholly sheathed in the foot.

Now let us look at the structure of these bristles. A few are simple hairs, but the majority are instruments of elaborate workmanship, though high powers of the microscope are needful to display them well. Each bristle consists of a transparent, yellow horny shaft, the extremity of which dilates into a slightly enlarged knob. This is cleft into four points, three of which are minute, but the fourth is developed into a long, slightly divergent, highly elastic, tapering, and finely pointed spear.

These organs come into operation when the animal would extrude its body from the mouth of its tube. Their action is manifestly that of pushing against the walls of the interior, which on close examination are seen to be lined with a delicate membrane, exuded from the animal's skin. The opposite feet of one segment protrude the pencils of bristles, one on each side, the acute points of which penetrate and catch in the lining membrane ; the segments behind this are now drawn up close, and extend their bristles ; these

catch in like manner ; then an elongating movement takes place ; the pencils of the anterior segments being now retracted, they yield to the movement and are pushed forward, while the others are held firm by the resistance of their holding bristles ; thus gradually the foreparts of the animal are exposed.

But the gradual process would ill suit the necessity of a creature so sensitive to alarm, when it wishes to retreat. We have already seen how, with the fleetness of a thought, its beautiful crown of scarlet plumes disappears within a stony fastness ; let us now look at the apparatus which effects this movement.

If we look at a *Serpula* recently dead,—which we may readily do, since it is the habit of most tubicolous Annelida to come out to die,—we shall find, with a lens, a pale yellow line running along the upper surface of each foot, transversely to the length of the body. This is the border of an excessively delicate membrane, and on placing it under a high power (say 300 diameters) we are astonished at the elaborate provision here made for prehension. This yellow line, which cannot be appreciated by the unassisted eye, is a muscular ribbon, on which stand up edgewise a multitude of what I will call combs, or rather sub-triangular plates. The edge of each plate is cut very regularly into six teeth, which curve in one direction, and one other curved so as to face these. The combs stand side by side parallel to each other, along the whole length of the ribbon, and there are muscular fibres seen affixed to the smaller end of every plate, which doubtless give it independent motion. I counted one hundred and thirty-six plates on one ribbon ;

there are two ribbons on each thoracic segment, and there are seven such segments:—hence we may compute the total number of prehensile comb-like plates to be about one thousand nine hundred, each of which is wielded by muscles at the will of the animal; while, as each plate carries seven teeth, there are between thirteen and fourteen thousand teeth hooked into the lining membrane of the cell, when the animal chooses to descend. No wonder, with so many muscles wielding so many grappling hooks, that the retreat is so rapidly effected!

A group of *Serpulae* of the species which I have been describing, is represented in Plate V.

CHAPTER VIII.

The floor is of sand like the mountain-drift,
And the pearl-shells spangle the flinty snow;
From coral rocks the sea-plants lift
Their boughs, where the tides and billows flow.

The water is calm and still below,
For the winds and waves are absent there;
And the sands are bright as the stars that glow
In the motionless fields of the upper air.

* * * * *

And life, in rare and beautiful forms,
Is sporting amid those bowers of stone,
And is safe, when the wrathful spirit of storms
Has made the top of the waves his own.

PERCIVAL.

A DRAG ON SMALLMOUTH SANDS.

I HAVE on two occasions described a dredging trip, undertaken principally under the north line of coast, ranging from Whitenose outward, and off shore towards the spot where the East Indiaman, *Abergavenny*, struck and sank with three hundred souls, about fifty years ago. The place is still familiarly spoken of by the fishermen under the ill-fated ship's name, or as they frequently abbreviate it, "the Abbey," and they pretend that the remains of the wreck may still be seen.

But frequently we varied the ground and its produce, by beating down to the southward, until we got

within Portland Roads, and then, reaching in-shore towards the ferry, as far as we dared for the shallows, dredged the ground over with the tide, in various traverses off Smallmouth Sands, and under Sandsfoot. The sand shoals off in some places very gradually, and one day we scraped along and stuck fast, the boat's keel deep in the mud and silt, and immovable, though the shore was more than half a mile distant. The tide, however, took us off after some delay, which no doubt seemed longer than it really was, and allowed us to go on with our dredging.

From this bay a favourable view is obtained of the equestrian figure of George III., which is cut on the slope of a hill above Preston, and which, by the exposure of the chalk, is very conspicuous on the green turf. It is a very remarkable work of art on several accounts ; first, for that it was executed by a private soldier with only his own resources ; secondly, for its colossal dimensions, being 174 feet in height ; thirdly, for its *vraisemblance* not only to a man on horseback, but to the king himself ; and fourthly, because being intended to be viewed at some miles' distance, on a very inclined surface, the drawing had to be made, not in natural proportions, but very considerably distorted : yet the success is complete.

In raking the bottom of this bay, we meet with various kinds of ground. In many places it is smooth sand ; in others a whitish, tenacious mud ; off Sandsfoot Castle the low ledges crop out, and offer their abrupt margins across the course in which we are working ; these have to be carefully avoided. Again, in some places there are extensive beds of *Zostera* ;

in others great, tangled, half-rotten masses of dead sea-weeds, such as *Rhytiphlea* and *Fucus*, with leaves of the *Zostera* twining among them, fill the dredge; most disappointing, because both unpleasant and unproductive. At other places we get stones, old shells, and nice specimens of living weeds.

The keer-drag on the sandy bottom takes several interesting fishes. Among them is the little Weaver (*Trachinus vipera*), a fish elegant in form and colour, but dangerous, and reputed to be poisonous. The first dorsal, which, being of a deep black hue, contrasts well with the chaste grey of the upper parts, is armed with very strong spines, and there is a long and very sharp one on each side of the head. The fish is said to direct its blows with these spines with great judgment and precision; and wounds inflicted by them are said to be peculiarly painful and difficult of cure. Hence possibly it was the Scorpions of the ancients:—

“Et capitis duro nociturus Scorpions ictu.”

OVID.

Other ground fishes I have also obtained here, as the Solenette (*Monochirus linguatulus*), and the Lemon Sole (*Solea pegusa*), besides more common kinds of Flat-fishes; and other species resembling these in form, colour, and habit, and as it were representing them, though widely differing structurally. I refer to the Skates and their allies. Pretty little specimens occur of the Thorn-back (*Raia clavata*), with numerous white spots, very round, distinct, and ocellated; and of the Painted Ray (*R. microcellata*), distinguished from

its fellows by several series of pale bands, forming concentric arcs sub-parallel to each of the four margins of the body. Mr. Yarrell speaks of this as very rare, but I obtained three examples in one day. The Bordered Ray (*R. marginata*) is another rarity which I have taken here, distinguished by the wide band of dark brown that margins the disk. The Angel (*Squatina angelus*) also sometimes comes up in the drag, a species intermediate between the Rays and the Sharks; but he is too hideous to dwell upon.

Some lovely little Nudibranch Mollusca frequently are found clinging to the meshes of the net; especially one of extraordinary beauty, when examined with a lens, though to the careless eye it appears dull and insignificant. I refer to *Aegirius punctilucens*, a little slug of pale reddish-brown hue, covered with tubercles, but studded here and there with black spots, in the centre of which is a speck of most lustrous green or blue, looking exactly as if a minute sapphire or emerald had been set there.

But perhaps most characteristic of this particular beat are the Crustacea. Various sorts of Crabs that occur in deeper water are also found here, as the Long-legged Spider-crabs (*Stenorhynchus* and *Inachus*); and the more sluggish sorts, as *Pisa*, *Hyas*, and *Maia*, whose rough shells are frequently so covered with a forest of growing sea-weeds, that, as they crawl and stagger along, they remind one of Birnam wood coming to Dunsinane. The true Shrimps (*Crangon*), or Sand-raisers, as they are not inappropriately called by the fishermen, are, however, peculiar to the shallow sands. Of this genus we have

five species at least in Weymouth Bay, some of which, remarkable for the variety and beauty of their colours, I have noticed elsewhere.* All the species burrow expertly in the sand, not entirely, but so as just to leave exposed the two eyes, which, like the garret-windows of a house (as Captain Harris says of the eyes of the Hippopotamus), are placed on the very summit of the head.

On the weeds and sea-grass those pretty Prawns are abundant which have been called *Aesops*, after the old hump-backed fabulist, because of the projection of the third segment of the abdomen dorsally, giving to these little Crustacea a curiously deformed appearance, when extended. The most common of our species, Cranch's *Aesop* (*Hippolyte Cranchii*), has the hump very strongly marked. It is a pretty, active little thing, darting rapidly from weed to weed, varying much in colour, but usually mottled and clouded with white and purple. In another species just described by Mr. Thompson, under the name of *H. Whitei*, the deformity is scarcely perceptible; and this is a particularly lovely kind, being as elegant in form as it is brilliant in colour, and therefore very desirable for an Aquarium. The whole of the animal is of a fine emerald-green, with a pure white line running down the back; the body sprinkled with specks of azure. In the tank this pretty species is not very lively, habitually clinging to sea-weeds and swimming little. Unfortunately it is the favourite prey of the larger Prawns (*Palæmones*), so that it cannot be preserved with these. If a few of the *Hippolytes* be turned

* Ann. of Nat. Hist. 1853.

into an Aquarium, of which the *Palæmones* are tenants, in a very few minutes each of the latter will be found to have captured one of the elegant strangers, and to be greedily devouring it.

Here, too, we got the Scarlet-lined *Æsop* (*Pandalus annulicornis*), a Prawn of larger dimensions, sufficient to entitle it to a place at our tables. You would at first sight mistake it for the common Prawn (*Palæmon serratus*), but for the diagonal stripes of rich red that run along each side of its pellucid body. It is a handsome species; but as I have not observed any peculiarities of importance in its economy, I content myself with a figure of it, which will be found in Plate VI.

THE PLUMOSE ANEMONE.

This species (*Actinia dianthus*) is by far the largest and most magnificent of our native Anemones, though I think I could hardly call it, with Müller, “*actiniarum pulcherrima*,” as it is excelled in beauty surely by *A. crassicornis*, and by several of the smaller species.* It varies greatly in size, form (so far at least as this depends on extension or contraction), and colour. I have seen specimens in the same colony, doubtless a family group, one-eighth of an inch in diameter, and others four inches. Dr. Johnston speaks of some five inches wide. Sometimes the same individual shrinks down to an abject flatness, and presently swells and rises

* A more extended acquaintance with the species has induced me to rescind this judgment, and to concur in Müller's verdict. (*Second Edition.*)

into a noble, massive column, from which the fringed disk expands and arches over on every side, reminding the beholder of a palm-tree. Then again, on some cause of alarm, real or supposed, it will suddenly close, and assume a distended globose appearance, with the oval mouth a little open, and filled with the clustering tentacles.

In colour the variety, though considerable, is restricted to certain limits easily defined. The most beautiful varieties that I have seen are the pure white, and the rich full orange or red-lead; but the more common states are cream-colour, flesh-colour, pale red, and olive. This last is perhaps the least pleasing hue, but there is considerable variation even here, for in some the tint approaches to a warm umber brown, and in others becomes a dingy, blackish olive. Generally speaking, the hue, whatever it be, is uniform in the same individual; but I possess specimens of the umber-coloured, in which the tentacles are almost white, imparting a peculiar speckled aspect to the disk; the crenated mouth in these is full orange.*

The body is smooth, lubricated with mucus, and perfectly free from sucking glands. It forms at the summit of the column a thick rounded rim, sometimes everted, not in the least crenated, within which a deep

* The specimen described in the Cornish Fauna, iii. 79, referred to by Dr. Johnston as probably belonging to another species, I should suppose to be but a variety similar to the above. The only thing remarkable in it that I see is, that it is said to live "between tide-marks." [This, however, I have since found to present no difficulty; since I have found this species abundant at Tenby, between tide-marks; and Mr. C. W. Peach informs me that such is its habit in the north of Scotland.] (*Second Edition.*)

groove exists around the exterior of the tentacular disk. The latter is membranous, expanded, and excessively puckered or frilled with broad and deep involutions, of which there are usually six or eight; the infoldings are sometimes simple, sometimes compound; in the latter case forming a semi-globose head of fine slender tentacles, crowded together in seeming confusion.

When more carefully examined, the membranous disk appears to be really circular in outline; the mouth, an oval orifice with crenated lips, is not placed on a cone; delicate lines, as usual, radiate from it. The innermost tentacles are placed at about half an inch from the mouth (in a large specimen); these are scattered irregularly and loosely; others succeed, more thickly, until towards the margin they become a dense fringe, defying enumeration. The innermost ones are stouter than the outermost: the length of both varies much in specimens of the same size;—sometimes being not more than one-fourth of an inch long, at others thrice this length.

The whole texture is somewhat pellucid, especially on the oral disk and the tentacles: the outer covering of the body appears sub-coriaceous, though soft and mucous.

In Weymouth Bay this species is very common, and still more abundant in the deeper water of the offing; both the dredge and the trawl constantly bringing up single specimens and clustered groups. The latter are sometimes very numerous, as many as twenty being not uncommonly crowded on a single oyster-shell. Of course such a group on so limited a

space, must include a good many small ones; generally they are of all sizes, from the gigantic forefather of the family to the tiny great-grandchildren that are scattered round his base, no larger than peas. In general all the members of each group are of the same hue; as they are, I presume, strictly one family. Yet one now and then sees an individual of quite another colour in the group; a circumstance to be accounted for on the supposition of an accidental intrusion on a ground already occupied. Flat stones, but more commonly large bivalve shells—such as oysters, pectens, and pinnæ—are the sites selected for the colonies of this *Actinia*.

Dr. Johnston's statement, that "*A. dianthus* is a permanently attached species, and cannot be removed from its site without organic injury to the base," is not confirmed by my experience. I find that it can be removed by the fingers without any difficulty, and that it adheres again to a fresh place with the same readiness as other *Actiniæ*. I have now in my Aquarium several specimens of large size, which I displaced in the usual manner, from their oyster-shells, by shoving them off carefully with the back of my finger-nails, and which I merely set down on the pieces of rock-work. I found them firmly fixed in the course of an hour or two, and they have manifested no disposition to unsettle themselves since, though they have been there for several weeks. On the other hand, one which I had put in with the shell to which it was affixed, presently crawled spontaneously from his original site, and took up a new abode on the rock-work. The change was effected by the ordinary

gliding movement of the base, and was not particularly slow. Indeed, I can state distinctly that *dianthus* crawls as freely as any other species.*

The rank odour noticed in *A. parasitica* is very powerful and enduring in this species also, as it is in *A. crassicornis*.

The principal object in the accompanying Plate, is an expanded specimen of the Plumose Anemone (*Actinia dianthus*) of the white variety, attached to an oyster-shell. In the front is a group of *Serpula contortuplicata*, with their cork-like opercula protruded, and their scarlet fans expanded. They are seated on a Scallop (*Pecten opercularis*); from which also springs a frond of the exquisitely delicate *Nitophyllum punctatum*. Behind the Anemone are some tufts of the Sea-grass (*Zostera marina*).

RUNCINA HANCOCKI.

On the 17th of September, I took this little Mollusk by hundreds on the *Zostera* left dry at low spring-tide, below Sandsfoot Castle. In raking the edges of the grass in the shallow pools with a ring-net, the little black, shining Nudibranchs were left on the cloth. Some were of much larger size than mentioned by Forbes and Hanley, being fully a quarter of an inch long when crawling;† while others were of various

* This fact has now been abundantly confirmed, not only by my own experience, but by that of many who at this time (1856), in London and elsewhere, are keeping *dianthus* in aquaria. (Second Edition.)

† I lately found in one of my tanks at London, a specimen of *Runcina Hancocki*, which was four lines in length when crawling, and stout in proportion. (Second Edition.)



P. B. Gosse Bell

Red and Orange Fish

— THE PLUMOSE ANEMONE &c

degrees of minuteness, down to half a line. When contracted, out of water, they presented a close resemblance to a glossy beetle—a *Gyrinus*, for example; but in crawling the body was considerably elongated.

In the Aquarium they are fond of crawling up the side perpendicularly till they reach the surface, when they float back downward, or more generally let go, bend in the foot, and drop at once to the bottom.

THE FIDDLER.

Beneath a large flat stone, exposed at extreme low water, at the end of one of the low rough ledges that run out from the foot of Byng Cliff, I found in September a full-grown specimen of the Velvet Fiddling Crab (*Portunus puber*). All the Crabs of this family, which contains a great number of species and not a few genera, are distinguished at once by a peculiar modification of the hindmost pair of feet, for the performance of an important function. They are all Swimming Crabs; and the facility with which they can roam through the element they inhabit, depends largely on the completeness of the modification which I refer to. Our common eatable Crab, the bulky, thick-clawed, livid 8-pounder, that lies with all his ten pairs of feet so meekly folded across his breast, can swim—about as well as a stone of the same size.

Now examine his hindmost feet; their single toe tapers to a sharp point, in no wise differing from those of the four pairs that precede them. But the *Portunidae*, or Swimming Crabs, have this last pair of feet much flattened out sidewise, and the toe in particular dilated into an oval, thin-edged plate; which,

striking obliquely upon the water, acts as an oar, with that peculiar action which is known to boatmen as sculling. In the common Shore-crab (*Carcinus mœnas*), that abundant olive-green kind which on every rocky shore little boys and girls catch, by letting down into the crevices a piece of string with a fragment of offal tied to it,—we observe a transition condition of the hind-foot; there is a decided tendency to an ovate form, though the tip is yet taper and acute. And the habits of the animal agree with this structure. The power of shooting slantwise through the water exists, which bears the same sort of relation to the free and easy swimming of the typical *Portunidae*, the Oceanic Crabs of the tropics, as the long leaps of the Flying Squirrels and the Petauri bear to the sustained flight of a bird.

None of our native Crabs are “at the top of the tree” in the swimming profession; their efforts, even those of the best of them (and there is a good deal of difference in the species even of the true *Portuni*), are awkward bunglings, when compared with the freedom and fleetness of those I have seen in the Caribbean sea, and among the Gulf weed, in the tropical Atlantic, which shoot through the water almost like a fish, with the feet on the side that happens to be the front all tucked close up, and those on the opposite side stretched away behind, so as to “hold no water,” as a seaman would say, and thus offer no impediment to the way. Our species are obliged to keep their pair of sculls continually working while they swim; a series of laborious efforts just sufficient to counteract the force of gravity; and the see-saw motion of the

bent and flattened joints of the oar-feet is so much like that of a fiddler's elbow, as to have given rise to a very widely adopted appellation of these Crabs, among our marine populace.

An old male of the Velvet Fiddler is a striking and handsome Crab. His body generally is clothed with a short velvety pile of a pale brown or drab hue, from beneath which here and there shines out the glossy deep black shell, especially where rubbed, as at the edges. The feet, particularly the plates of the oars, are conspicuously striped with black; the large and formidable claws are marked with bright scarlet and azure, as are also the foot-jaws and face; while the eyes are of the richest vermillion, projecting from hollow black sockets.

I said that he is a "striking" Crab; and, though I was quite innocent of a pun when I wrote the word, it is characteristic in more senses than one. Both it and its frequent companion, the Shore Crab, when apprehensive of assault, use the powerful claws, not to seize, but to strike transversely, as a mower uses his scythe; and this action they perform viciously, and with great force and effect.

In the Aquarium the Velvet Fiddler was shy and recluse. He at once slid into the most obscure recess he could find, beneath the dark shadow of two pieces of rock that formed an arch. For some days he remained gloomily in his new castle; but at length he ventured out under the cover of night, and would wander about the floor of the tank. But he never lost his cautious suspicion, and the approach of the candle was usually the signal for a rush back to his dark re-

treat. He was a fit representative of one of those giants that nursery tradition tells of, as infesting Cambria and Cornwall, "in good King Arthur's days." Gloomy and grim, strong, ferocious, crafty and cruel, he would squat in his obscure lair, watching for the unsuspecting tenants of the tank to stray near, or would now and again rush out, and seize them with fatal force and precision. As the Giants Grim of old spared not ordinary-sized men for any sympathy of race, so our giant Crab had no respect for lesser Crabs, except a taste for their flesh. I had two or three full-grown Soldier Crabs (*Pagurus bernhardus*) ; themselves warriors of no mean prowess ; two, at least, of these fell a prey to the fierce Fiddler. His manner of proceeding was regular and methodical. Grasping the unthinking Soldier by the thorax, and crushing it so as to paralyse the creature, he dragged the body out of the protecting shell. The soft, plump abdomen was the *bonne bouche*; this was torn off and eaten with gusto, while the rest of the animal was wrenched limb from limb with savage wantonness, and the fragments scattered in front of his cave.

I saw him one day snap at a Prawn, but the elegant and agile animal was much too quick to be so caught: with a flap of its tail it shot away backward, and laughed its enemy to scorn.

There was a large Sea-worm, however (*Nereis pelagica*), a many-footed, Centipede-like creature, some seven inches long, that fared worse. The Fiddler seized the worm in one powerful claw, and began to gnaw it up as we do a radish : the writhings of the victim interrupted the epicure's enjoyment ; he there-

fore took hold with the other claw also, and soon bit the body into two pieces, which continued to writhe and wriggle to the last. The giant's dinner in this instance lasted about an hour.

The Crabs are the scavengers of the sea; like the wolves and hyenas of the land, they devour indiscriminately dead and living prey. The bodies of all sorts of dead creatures are removed by the obscene appetite of these greedy Crustacea; and there is no doubt that many an enormous Crab, whose sapidity elicits praise at the epicure's table, has rioted on the decaying body of some unfortunate mariner. But what of that? Let us imitate the philosophy of the negro mentioned by Captain Crow. On the Guinea Coast people are buried beneath their own huts, and the Land-crabs are seen crawling in and out of holes in the floor with revolting familiarity: notwithstanding which, they are caught and eaten with avidity. A negro, with whom the worthy Captain remonstrated on the subject, seemed to think this but a reasonable and just retaliation, a sort of payment in kind; replying with a grin and chuckle of triumph:—"Crab eat black man; black man eat *he!*"

THE POGGE.

An "odd fish," rejoicing in the elegant cognomen of Pogge among the vulgar, but known to the scientific votaries of sesquipedalianism by the title of *Aspidophorus cataphractus*,* is occasionally found lurking

* This little unconscious fish has as many aliases as a house-breaker, to say nothing of his hang-gallows look. According to Mr. Yarrell's list of synomynes, he is the Armed Bullhead, the Pogge,

about the quays of Weymouth. Men and boys who collect prawns and shrimps (the latter term used in its popular, not its zoological sense) go round in boats along the sides of the sea-walls, as well those outside of the harbour forming the esplanade as the commercial quays. These at low-water-line are clothed with a ragged olive fringe of *Fuci*, chiefly *F. serratus*, which hang down in an almost uninterrupted line of dense tufts, affording shelter to many small animals. The fisherman is provided with a *lamm*, a kind of bag-net, the frame of which is in the form of a bow of four feet diameter, the place of the chord being occupied by a stout piece of wood, from the centre of which passes a staff eight feet long, crossing the bow, to whose middle it is fastened. The net is a bag fixed to the bow and chord. It is used in this manner: The fisherman, dipping it beneath the hanging weeds, raises it to the surface, shaking it, and as it were raking the weeds with its chord; his comrade slowly pushing the boat meanwhile along the quay. After two or three dips he examines his success, picks out the prawns and shrimps, and deposits them in a bag at his waist, and throws out contemptuously all "rubbish."

It is this "rubbish," however, which to any one but the prawn-catcher constitutes the main *game*. Many interesting little creatures have I got in this way. Among the fishes this Pogge has occurred two

the Lyrie, the Sea-poacher, the Pluck, the Noble; while the admirers of Greek and Latin may choose between *Aspidophorus Europaeus*, *Cottus cataphractus*, *Cataphractus Schoneveldii*, and *Aspidophorus cataphractus*.

or three times ; chiefly small specimens not more than two inches, or three, in length ; but one among them had attained the length of five inches, nearly the full dimensions of the species. The small ones were black, but the larger a dull, dirty grey. The most marked peculiarity of this little fish is its armature ; it is clothed, like a knight of the age of chivalry, in a suit of plate-mail, *cap-à-pie*. Every one of the bony plates of which its *lorica* is composed is furnished with an elevated central keel ; and as the plates run in regular longitudinal series, the surface of the body is armed with eight elevated sharp ridges running from head to tail. The huge head bristles with spines and bony points, and the nose terminates in a couple of spines that stand up and curve backwards like the horn of a Rhinoceros in miniature ; while the whole under-surface of the head, which is flat, is covered with a beard of horny, thread-like filaments, very numerous and close-set, hanging perpendicularly downwards. Let me not, however, be understood as speaking disrespectfully of this *mental* adornment ; for I doubt not it would be considered quite an elegant appendage in Regent Street or Pall Mall.

In the Aquarium the Pogge soon showed how exclusively he is a bottom-fish. Though his fins are ample, he has scarcely any power of swimming except by strong muscular effort, struggling upward for a little distance, and sinking to the bottom the moment the effort is relaxed. In general it lay motionless on the ground, while I had it ; and I presume this is its habit when at liberty. The beard-filaments are probably delicate organs of touch, endowed with a high

sensibility; and these, when the fish lies on a soft bottom, such as mud or sand, would be partly buried in it, and would be cognisant of the presence of any Annelide or Echinoderm that might be burrowing in the ground or crawling over it, fit for the capacious mouth to engulf, and the ample gullet to swallow.

THE NOTHE LEDGES.

In pursuing the line of shore which extends from the foot of the Lookout to the Nothe Point, beneath a range of low, crumbling, marly cliff, we pass for a while over nearly horizontal ledges, which dip successively into the sea, as I have more than once had occasion to mention. This is a rich collecting ground. The broad, shallow, half-tide pools afford *Anthea cereus* of the grey variety, *Actinia mesembryanthemum*, and *A. crassicornis*; and in the latter part of summer *Padina pavonia* grows in them. Those parts of the ledges that are uncovered only at the lowest tides, yield the green-tentacled and crimson-tipped variety of *Anthea*, very brilliant and silky, and in great profusion; and among the sea-weeds, two or three kinds of *Cladophora*, *Corallina*, and *Jania*, thick tufts of *Rhytiphlaea pinastroides*, and some *Polysiphoniæ* and *Callithamnia*.

After we have passed along for some distance, the cliffs begin to grow more lofty, and more solid and rocky in their character; the pools disappear, and the ledges become more rough, and more indented with deep narrow fissures, until they terminate in an ab-

rupt wall or quay, which protects a tiny mimic bay. This little indentation is a most prolific source of washed sea-weeds in the summer and autumn, and many specimens of rarity and beauty are gathered here. The rich and brilliant *Rhodymenia laciniata* is not uncommon, and the more delicate and scarcely less beautiful *Nitophyllum punctatum* (see Plate V.), with *Delesseria sanguinea* and *sinuosa*, and many other species equally attractive, occur. Some of these are, it is true, deep-water kinds, washed in by the tides; the first named, for example, I have never met with in a growing state; but this little bay is particularly rich in littoral species. At the bottom of the wall or quay-like edge grow several fine tufts of those very elegant Algæ, *Griffithsia corallina*, and *G. setacea*; *Ceramium echionotum* (see Plate VI.) and *C. ciliatum*, exquisite plants for microscopic study, are also scattered about in the lowest levels, though not often uncovered; and the fissures which penetrate the stone are well fringed with *Delesseria alata*, *Dasya coccinea*, *Chylocladia articulata*, *Ptilota plumosa*, and other shade-loving species, that grow in dense mossy tufts. The only living specimen that I found at Weymouth of *Delesseria sanguinea*, was growing in one of these clefts, where also small and brightly-coloured specimens of *Pyllophora rubens* occur;—a plant which is obtained much more abundantly, and of far greater dimensions, by the dredge. This is an Alga of much value for the Aquarium. It is elegant in form and colour; it bears confinement perfectly, and throws off a large quantity of oxygen; besides which it is almost always studded with multitudes of parasitic

animals, particularly the smaller Zoophytes, and the branching *Bryozoa*.

The higher clefts in this vicinity produce *Codium tomentosum*, rather a rare plant here, which I value because upon it, as on a pasture, I almost always find a lovely little mollusk resembling the Nudibranchs, —*Acteon viridis*,—whose green coat is spangled over with most lustrous specks of blue and green, as if it were powdered with gems. This plant is useful though not elegant, as it affords a favourite food, not only to this, but to other species of phytivorous Mollusks, and it will survive well in a confined vessel of sea-water.

Griffithsia setacea, which I have mentioned above, is a beautiful inhabitant of an aquarium, and one which thrives in confinement. Professor Harvey speaks of the ease with which it is domesticated ; * and my experience agrees with his. Its attachment to the rock is commonly slight, and its base minute, so that it is sometimes difficult to procure a firmly-growing specimen ; still, however, it lives and grows, though with barely sufficient base to hold the filaments together. (*See Plate II.*)

The surfaces of the rocks are studded between tide-levels with that curious plant *Rivularia nitida* ; which is sure to attract attention, with its little shining balls of vivid green colour, like school-boys' marbles, lying on little beds of vegetation that adhere to the naked rock. We attempt to take them up, and find them blown bladders of tender gelatinous membrane ! In the early autumn this singular plant occurs in abun-

* Phycol. Brit. p. 184.

dance on this spot, though it is said to be rare on our shores generally.

From this point onwards to the Nothe, the cliff is more and more precipitous, and the shore encumbered with immense blocks that have fallen from above, and lie confusedly heaped upon each other. The under surfaces of these angular masses occasionally yield fine specimens of some of the more delicate *Algæ*, but, generally speaking, the result scarcely repays the labour and difficulty of their examination.

CHAPTER IX.

Ask now the beasts, and they shall teach thee ; and the fowls of the air, and they shall tell thee ; or speak to the earth, and it shall teach thee ; and the fishes of the sea shall declare unto thee. Who knoweth not in all these that the hand of the Lord hath wrought this ?—JOB xii. 7—9.

The heavens declare the glory of God, and the firmament sheweth his handiwork. Day unto day uttereth speech, and night unto night sheweth knowledge.—PSALM xix. 1, 2.

THE RIGHT USE OF NATURAL HISTORY.

ON a bright sunny morning in September, I found myself on a lonely part of the shore about a mile from the town. I had taken the gratification of a bathe, and felt invigorated, but not wearied, with the exertion of swimming. I had come down to this part of the shore to search a particular ledge at the lowest water of spring-tide, but I had somewhat anticipated my time, as the tide had yet a full hour to recede. Compelled therefore to involuntary idleness, I laid my collecting basket on the white sand, and sat down on one of the blocks of red conglomerate, immediately under the ruins of Sandsfoot Castle, which crown the edge of the cliff, already partly fallen, and threatening, at no distant date, to descend, a mere heap of disjointed stones, upon the beach.

My thoughts began to run on the utility, the real legitimate object, of Natural History ; the manner in

which, and the motives with which it should be studied, with relation to Religion. Many persons of eminence seem to have considered it and kindred studies as the only occupations worthy of exalted minds, as if the acquisition of intellectual knowledge formed the chief end of existence both here and hereafter; while multitudes of humble believers are afraid of all natural science, and stand aloof from it, as if its influence were necessarily adverse to true piety. The truth, as usual, probably lies between the two extremes.

It seems a sufficient reply to the scruples of the pious, but perhaps ill-instructed, persons last mentioned, to take the Holy Scriptures in our hands, and point out how large a place natural science occupies therein. The Holy Spirit has deigned to employ it in all ages as a vehicle of instruction to man; and there is scarcely a single book in the whole Bible, from which this proposition might not be proved. The most devotional parts of the Book of God, such as the Psalms, particularly those later ones in the collection, which are emphatically "Psalms of praise;" and the Song of Songs; the direct appeals of Jehovah himself; and the words of Him who spake as never man spake,—would afford us the most abundant materials for the evidence.

On the other hand, he must grossly miss the intent of the Sacred Word, who supposes that even in such passages the communication of natural knowledge is the chief end proposed. Some of the attributes of the Creator, indeed, may be deduced from his works, and man is held responsible for the deduction. But if

this be attained, it will go but a little way towards that “acquaintance with God” which will set a man “at peace,” and to communicate which is the object of the Divine Revelation. A man may be a most learned and complete expounder of the truths of natural theology, and yet be pitifully blind on the all-important subject of a sinner’s justification with God.

Perhaps the best mode of arriving at the true use of the natural sciences, is to examine how they are treated in the Word of God. And it appears to me that there are three distinct modes of instruction, under one or other of which, most if not all of the passages which speak of natural objects may be arranged.

I. *The direct Testimony which the Creatures give to God.*

When Jehovah breaks in upon the unsatisfactory conference between Job and his friends, He uses this vehicle of instruction. The construction of the material universe, the phenomena of light and darkness, of heat and cold, of meteors, the revolutions of the heavenly bodies, the structure of the earth, the proportions of land and sea, and especially the economy and instincts of various animals, are appealed to, in a series of interrogations of unparalleled majesty, as witnesses to Him. But here there are two methods of appeal. The one rests on man’s ignorance, the other on his knowledge. “Knowest thou the ordinances of heaven? Canst thou send lightnings, that they may go, and say unto thee, Here we are? Knowest thou the time when the wild goats of the rock bring forth?”

(Job xxxviii. xxxix.) These are queries calculated to abase and humble proud man. There are thousands of effects which we perceive, but of which all our philosophy fails to discover the cause; so that we must continually say with Agur, “There be three things which are too wonderful for me; yea, four which I know not.” (Prov. xxx. 18.) “As thou knowest not the way of the spirit, nor how the bones do grow in the womb of her that is with child; even so thou knowest not the works of God who maketh all.” (Eccl. xi. 5.) Here then, at the outset, our much ignorance ought to humble that pride and self-sufficiency which is too apt to be the accompaniment of a little acquaintance with natural science. While the contemplation of the perfection with which everything is ordained and governed, ought to make us satisfied with the Divine Wisdom, and to check our repinings when its ordinances do not agree with our inclinations. An humble, teachable, child-like spirit, ready to receive every revelation of God, becomes one who looks on the Divine handiwork.

Still we can trace much in the created world, which we are able to understand, much of which we can perceive the reasons, and discern the fitness. And several of the perfections of God may clearly be inferred from these, being reflected by his works as by a mirror. These his perfections, “his eternal power and Godhead,” have been *manifested* in the things that are made, as He himself informs us; for “He hath shewed them unto us,” (Rom. i. 19, 20.) So that we are without excuse, if we see Him not in them. Thus, the greatness and power of God are insisted on in the passage already alluded to (Job

xxxviii—xli.),—from his formation and control of the planets, the ocean, the lightning, the hugest and most terrible of beasts, and so forth ; as from his entire and absolute command of the elements (Psalm cxlvii. 15—18) in accomplishing his irresistible decrees. The wisdom of God, including his wondrous contrivance in planning, and skill in executing his works, is seen in the multitudinous varieties of form in the creatures, in the correspondence of part with part, in the perfect adaptation of organs to their uses, in the wonderful and unerring instincts of animals, in their relations to the places which they inhabit, and in the general bearing of the details of creation on the order, stability, and well-being of the whole (see Job xxxviii. &c. ; Psalm civ. 17—24 ; cxlvii. 4). The eternity of God may be inferred from the circumstance of creation having been prior to all creature experience (Job xxxviii. 21 ; Psalm civ. 31) ; and his immutability from the stable order of the universe ; from the unerring regularity of the celestial orbs (Psalm lxxxix. 37 ; civ. 19 ; Jeremiah xxxi. 35, 36) ; and from the constant renewal of the face of nature (Psalm cxlviii. 6). The omnipresence and ever watchful providence of God are in like manner taught us by the constant and universal harmony of the vast machinery of creation (Psalm cxxxix. 7—12). But perhaps the most obvious lesson which we learn from the creatures, at least the animate creatures, as it is the one most frequently insisted on in the Word, is the kindness of God, the benevolence of his character, manifested in his tender care for their comfort, and his rich supply of all their need. It is hardly neces-

sary to cite particular passages; almost all those which I have already adduced have this bearing; but in addition to them there are the teachings of the Lord Jesus, which on several occasions pointed in the same direction. Would He inculcate a confident trust in our Heavenly Father for the supply of needed food? He enforces it by these words:—"Behold the fowls of the air, for they sow not, neither do they reap, nor gather into barns; yet your Heavenly Father feedeth them." (Matthew vi. 26). Are we tempted to be anxious for raiment? The beauteous array of the lilies of the field reads us a homily of the Divine care over them, and therefore *à fortiori* over us (verse 30). Would our gracious Master guard us against "the fear of man which bringeth a snare?" He sends us to the sparrows, and tells us that "not one of them shall fall to the ground without our Father" (Matt. x. 29).

This, then, is one important use to be made of the study of natural science; it brings us, in some sense, into the presence of God; or rather it gives us cognisance of Him, and reveals to us some of his essential attributes. But here natural theology stops. Beyond this point it cannot go a single step *as a guide*; though, *as a companion*, it may still accompany us under the tutelage of another directory. This might have sufficed us if we had stood in Adam's position of unsinning innocence; we might have come to God with our offering of praise gathered from our consideration of his works, and have been accepted. But to come to Him *now*, with such a tribute *and nothing else*, is to offer Cain's offering; to plead *not guilty*

to the charge brought against us in the court of Divine Justice, and to ignore the only way of reconciliation. This, I fear, too many of our philosophers and natural theologians do. They offer Cain's "fruit of the ground," without the blood of Abel's "firstling." But it is not and cannot be accepted; for there is no way into the Holiest but by the Blood of Jesus. Natural religion can tell us, *ex cathedra*, nothing about this. When an anxious conscience demands to know something more of God, something of his feelings towards offenders, of his way of dealing with rebels, whether there is forgiveness with Him, and mercy,—the creatures are mute. One says, It is not in me! and another says, It is not in me! All are ominously dumb on such questions as these.*

To enlighten us on these points is the grand object of the Word of God. It reveals to man the full hopelessness of his state, drawing aside the curtain from that hideous scene of eternal and utter ruin into which he had fallen by sin. It reveals also the remedy, God manifest in the flesh, bearing as a substitute human guilt, that through the blood-shedding of one spotless and infinitely perfect Victim, there might be full and free justification for every one that believeth.

* Natural theology is quite overrated by those who would represent it as the foundation of the edifice: it is not that, but rather the taper by which we must grope our way to the edifice. . . . It is not that natural religion is the premises, and Christianity the conclusion; but it is that natural religion creates an appetite which it cannot quell: and he who is urged thereby, seeks for a rest and a satisfaction which he can only obtain in the fulness of the Gospel.—*CHALMERS, Bridgewater Treat. ii. 290, 291.*

When this grand inquiry, this *quæstio quæstionum*, is settled authoritatively by the Divine Oracles, the creatures may again come in, and teach us, subordinately, many useful lessons. We are thus brought to the second method of instruction.

II. *Moral lessons conveyed by examples.*

Thus the wisest of men sends the sluggard to the ant; that his sloth may be reproved by the contemplation of her diligence (Prov. vi. 6—8). Thus Agur teaches foresight from the same insects, prudence from the conies, order and combination from the locust, assiduous persevering industry from the spider, and propriety and dignity from various other animals (Prov. xxx. 25—31). Thus too the Lord affectingly contrasts the brutish ingratitude of Israel to Himself with the affection of the ox and the ass to their master (Isa. i. 3); and their stupid ignorance of his coming judgments with the instinctive foresight of the migratory birds (Jer. viii. 7). After the same manner the stubborn wilfulness of the unbroken horse or mule is held up as a character to be avoided by the people of God (Psalm xxxii. 9). By a process of thought somewhat similar, the inspired Preacher reads the stamp of vanity on earthly things, from the perpetual change and decadence of all creatures. (Eccl. i. 4—7.)

III. *Spiritual parallelism by way of symbol or analogy.*

This is a mode of treating natural objects very extensively adopted in the Sacred Word. Truths thus presented find acceptance where they would have

been rejected if offered in an abstract or didactic form ; they insinuate themselves insensibly, while the mind is pleased in tracing the resemblance of the shadow to the substance. It is a very ancient notion, that all things have been created, as it were, in series, each of which is, in all its members, a representation or counterpart of all the rest. Or, as the Platonists expressed it, that “ the Creator having conceived in Himself the exemplars of all things, produces them from Him in images.” The whole system of Scriptural parabolism and typology depends on this analogy, which assuredly exists, though perhaps not to the extent assumed in the above notion.

Examples of this use of natural objects are numberless in the Holy Scriptures, and will occur to every thoughtful reader. Often the resemblance is confined to a single point, and is alluded to in a simile or comparison ; as when the effect of a single indiscretion upon character is likened to a dead fly in a pot of ointment (Eccl. x. 1) ; the state of a sinner wandering from God, to that of a sheep going astray (Isa. liii. 6) ; and the inveterate love of sin, to the incorrigible filthiness of the dog and the swine (2 Peter ii. 22). The Book of Proverbs and the Song of Songs are full of these similes, those of the latter poem often running into the more elaborate allegory.

Somewhat like this is the adoption of natural objects to form types, emblems, or symbols. These commonly suggest many points of parallelism, though they are not always expressed. The various types of the ritual law illustrate this use ; as do also the extensive series of images employed in the symbolic

prophecies of Ezekiel, Daniel, Zechariah and John. Thus, when the Lord Jesus is represented by a Lamb (John i. 29, &c.), the figure alludes to the meekness, purity, submission, and fitness for sacrifice of that animal; and when He stands as the lion (Rev. v. 5), the qualities of power, prevalence, majesty, and terribleness, are comprehended in the symbol. The mystic cherubim,—whether they represent the church or the heavenly angels, or both,—are pictured by various animals (Ezek. i.; Rev. iv.); and the change of character which the kingdom of Christ will introduce upon earth, is figured by the harmonious companionship of ferocious creatures with those of gentle dispositions (Isaiah xi.).

But not infrequently the parallelism is drawn out and expanded into so many particulars as to constitute an allegory or parable. Thus Jotham instructs his people by the story of the trees selecting a king (Judges ix.); the prophet Ezekiel sketches the history of Assyria under the emblem of a cedar (Ezek. xxxi.), and Nahum depicts the same ferocious monarchy under that of a lion (Nah. ii. 11—13); the former prophet again represents the Egyptian king as a crocodile, and graphically describes him as caught in the net of the nations (Ezek. xxxii.); and gives a most vivid picture of Israel, under the imagery of a lion's whelp trained by the old lioness to the love of blood, and at last taken in the toils (Ezek. xix.). The frequency with which the vine is chosen as the subject of allegorical representation is remarkable; as are also the variety and copiousness of the details which are employed to depict it (See Ps. lxxx.; Isa. v.; Ezek.

xv. ; xix. ; Matt. xxi. ; John xv. ; and several other passages). Many of the parables of the Lord Jesus come under this head ; as also a large portion of the Song of Songs.

The examples which I have here selected might be greatly extended ; but these are more than sufficient to illustrate the way in which the Word of God sanctions the study of his works. Not only do these passages require a considerable amount of acquaintance with the qualities of external objects, in order to be understood ; but they afford us a warrant for a similar use of them. Not only is it legitimate to deduce the existence, and somewhat of the character of God from the creatures, but we may use them as remembrancers to *suggest* many truths which they could not *teach* us. Truths and doctrines which we could only learn from the written Word may be vividly brought to mind by the suggestive and emblematic imagery of nature. And thus the world of created things around us may become a mirror continually reflecting heavenly things.

This is one of the happiest and most profitable employments of natural science. I would that it were more familiar, more habitual to me. It is a good thing to see the *Creator* in his works ; but it is far better to trace in them the God of revelation, the God of Grace, the God and Father of our Lord Jesus Christ, and of all who believe in his name. If we stop short at the former discovery, it will be of little avail to us. We shall be like a prisoner under sentence of death, who, when the king sends him terms of life and freedom, should occupy himself solely with

the genuineness of the credentials, to the utter disregard of the message :—should, after a minute examination of the seal, triumphantly exclaim, “ Yes ! this clearly proves, what I have long suspected, that there is a King !” and should then complacently turn to his dungeon-wall, and hug his chain, without a glance at the document which has been sent to him !

CHAPTER X.

Forthwith the sounds and seas, each creek and bay,
With fry innumerable swarm :
. part single or with mate
Graze the sea-weed their pasture, and through groves
Of coral stray ; or, sporting with quick glance,
Show to the sun their waved coats dropp'd with gold.

MILTON.

THE TRUMPET LUCERNARIA.

THE summer was over, but I still lingered at Wey-mouth. Spring-tides came and went with tantalizing regularity ; but, though the sea receded far below the lowest level reached in summer, it was almost unavailable to me. Day after day I used to go down and look upon the ledges, but fierce autumnal gales blew with characteristic violence and pertinacity, and huge seas rolled in, sweeping over the flats, shooting up in forcible jets from the fissures, and laying bare for a moment large tracts of inviting sea-weeds, only to cover them the next a fathom deep.

In a brief interval of gentleness, however, I found an animal which had long been an object of desire to me, a normal form of the genus *Lucernaria*. The small, aberrant, vase-like species, *L. cyathiformis*, I had taken already ; but I wished to see the more elegant sorts, which resemble in figure the trumpet-shaped flower of a *Convolvulus*, representations of which by

the pencil of Mrs. Johnston I had been in the habit of admiring, in her husband's admirable "History of British Zoophytes."

It was on the 3rd of October that I detached, at that sort of little natural pier that I have described under the Nothe cliffs, a frond of *Fucus serratus*, with a bushy tuft of *Rhodomela subfusca* growing parasitically on it. To one of the branchlets of the latter plant a little mass of jelly was adhering, which, on my dropping the branch into a phial of water, presently expanded, and I had the pleasure of seeing the bell-like form of *Lucernaria auricula*. It was a very young specimen, not much more than one-eighth of an inch in height; but I had got a clue to the search, and I subsequently obtained, through the month of October, many more. In spite of the gales and seas, I managed to drag up a good deal of the *Fucus*, which is hereabout profusely fringed with *Rhodomela*, and also with *Ceramium rubrum*; and on these, as also occasionally on the *Fucus* itself, and once or twice on *Padina*, I found the Lucernariæ.

My mode of examination was as follows. Collecting a basketful of the tufts at random, I brought them home; then one by one I waved them to and fro, in the tank of water, between my eye and the light, whereby the animals became distinctly discernible, and were easily detached. Sometimes four or five were scattered over one tuft of the parasitic plant, and it was rare to find a *Rhodomela* of any size, without one at least.

The specimens were evidently the young of the season; many were no larger than I have named; but

some were as much as one-third of an inch in diameter. They were very beautiful, closely resembling a bell, or trumpet-mouthed monopetalous flower, with a short flexible footstalk, and a small, expanded, sucking-disk at the base. The substance was clear, transparent, gelatinous; the flower-like expansion thin and filmy, with the margin projecting into eight equi-distant points. From each of these points radiated about twenty slender tentacular threads, bearing at their extremities orange or yellow globules. The ovaries radiated in eight irregular bands from the centre of the flower to the marginal points, and from the centre itself projected a little, protrusile, four-cleft mouth; closely like the peduncle of a *Thaumantias*. Indeed I was strongly struck with the resemblance which the creature bore to a small Medusa, and I consider it as a link that connects the normal Actiniæ with the Acalephæ.

In some specimens there were eight little oval warts, which hung from the outside of the margin, placed midway between the angles or points. Montagu has made these warts the distinctive character of this species; but I think they are not to be depended on; for many of my specimens, not at all to be distinguished from these in form, colour, or habit, were destitute of the least trace of the warts. It is possible that it may be a distinction of sex.

The specimens were very difficult to preserve alive. The beautiful groups of globe-headed threads soon contracted and agglutinated into shapeless masses, the hold of the foot loosened, and the animal dropped helpless to the bottom, and decayed. Indeed, I found

that the hold was very readily let go, even in health ; the little animal travels quickly, causing itself to adhere to any substance, either by the contact of the tentacles, of the marginal warts, or of the foot-disk.

From what O. Fabricius says of the food of this species,—“*vescitur oniscis*,”—I presented to one a little *Gammarus locusta*; the *Lucernaria* strove to take in the prey with its mobile mouth, and succeeded in partially embracing it, holding it for several hours, after which it dropped it. The shrimp was early rendered powerless.

In colour these delicate creatures vary much. The expanded membrane is usually colourless ; but the mouth, the ovaries, the edges of the disk, and the foot display colour. This may be grass-green, olive, drab, whitish, or various shades of rose-pink. The warts are commonly whitish, and the tentacle-globules pale orange yellow. In some specimens, opaque-white specks were scattered over the disk, which in others were absolutely wanting. The nature of these I cannot conjecture.

In February of the present year (1854) Mr. Thompson of Weymouth was so kind as to send me up several specimens of what I take to be a distinct species, *L. campanulata*. It is less elegant, more cup or bell-shaped, with scarcely any perceptible stalk. These specimens were about an inch in height, more dense in texture, of a dark dull green hue.

My friend has favoured me with the following notice of the habits of this species. “The *Lucernarie* I find as follows :—at extreme low water, beds of sea-grass (*Zostera marina*) are exposed ; on some of

these, little pools, four or five feet across and eighteen inches deep, are formed, the matted roots of the *Zostera* having been washed away. The bottom of the pools is of clear sand, with innumerable broken tubes of a species of *Sabella* [*Terebella*?] and a few *Pagurus bernhardus*, all small specimens; also *Venus striatula* and *Mactra stultorum*. On the surface of these little lakes, and round the edges, float the leaves of the *Zostera* which grow nearest the margin; and attached to these leaves on their under-sides, with the mouth and tentacles downwards, rests the *Lucernaria* on the watch for prey; at times in a state of rest, at others in constant motion. The heads of the tentacles possess great power of adhesion, and I expect you will find the filaments or threads highly developed."

The accompanying plate represents two specimens of *Lucernaria auricula* attached to a pendent thread of sea-weed. In the foreground is that fine bivalve (*Pectunculus glycimeris*), which is taken in deep water in this Bay; its summit is covered with the common Acorn-shell (*Balanus balanoides*); on which rests the scarlet-lined Æsop-prawn (*Pandalus annulicornis*). Behind this spring two fronds of the Ladies' tresses (*Laminaria phyllites*). From the rock above the *Lucernariæ* is growing a bushy tuft of a coarse but curious Alga (*Ceramium echionotum*); and below is seen a plant of exquisite structure, one of the most simple, but one of the most lovely of sea-weeds, the *Bryopsis plumosa*.



Hannart, Cheneau & Cie.

THE AESOP PRAWN &c



A LAST LOOK AT WEYMOUTH.

In this changing state, the *brightest*, like

“—— the *darkest* day,
Live till to-morrow, will have pass'd away ;”

— the summer, only too swiftly, passes into autumn, and autumn quickly merges into gloomy winter. The sea-side has few charms in December; reluctantly, we took our last walk upon the now bleak and spongy Nothe, our last stroll along the gusty and deserted Esplanade, and our last look at Weymouth. This, however, was a charming one. Just half-way between Weymouth and Dorchester, the hills, which rise gradually on each side, attain their greatest elevation, and the high road passes over the summit of the ridge. Here we made the carriage halt, and for ten minutes

“—— cast one longing lingering look behind,”

on a widely-expanded panorama of the scenes with which we had been so familiar. The sun and sky were all that could be wished; the air more autumnal than wintry; and, as we gazed on the town and harbour, about four miles distant, the long promontory of the Nothe, the calm, silvery Bay, the huge mass of Portland, like a sleeping lion, and the boundless expanse of open sea beyond, we could not help feeling that this was by far the finest prospect we had seen in Dorsetshire.

But even in London, thanks to the Aquarium, the same pleasant studies can be prosecuted that had occupied me on the coast; and thus, by means of a few specimens that I brought up with me, and by the aid of contributions forwarded to me by the kind

courtesy of friends, I have yet a few more notes to add to the zoological portion of this volume. The chief of these collections were sent to me by Mr. William Thompson from Weymouth, and by the Rev. C. Kingsley from Torquay; and to these gentlemen, as well as to other friends who have aided me, I beg thus to express my greatest obligations.

THE SPINOUS COCKLES.

Among a number of animals of great interest, sent to me in January from the vicinity of Torquay, by the courtesy of the Rev. C. Kingsley, were a posse of Cockles; not the plebeian sort, that boys with sten-torian lungs cry about the streets of sea-port towns at "two-pence a quart," but those giants, *Cardium aculeatum* and *C. tuberculatum*, the real aristocracy of the cockle kind. The favour of the kind donor was the greater, as the sands of Livermead and Paignton, whence these were procured, are almost the only British locality for the species, especially for the latter, which is among the rarest as well as the finest of our native bivalves.

They looked healthy when turned out of the jar, though they had performed their journey up in that bitter, almost Arctic weather, that we had at the beginning of January; and, under the excitement of the genial atmosphere of the parlour, they presently grew quite frisky. Many persons are aware that the Common Cockle can perform gymnastic feats of no mean celebrity, but the evolutions of Signor Tuber-culato are worth seeing. Some of the troupe I had put into a pan of sea-water, others I had turned out

into a dish dry, as knowing that an occasional exposure to the air is a contingency that they are not unused to. By and by, as we were quietly reading, our attention was attracted to the table where the dish was placed, by a rattling uproar, as if flint stones were rolling one over the other about the dish. "Oh! look at the Cockles!" was the exclamation; and they were indeed displaying their agility, and their beauty too, in fine style. The valves of the largest were gaping to the extent of three quarters of an inch; but the intermediate space was filled up by the spongy-looking, fleshy mantle, of a semi-pellucid orange hue. At one end protruded the siphons, two thick, short tubes, soldered as it were into one, and enveloped on all sides in a shaggy fringe of *cirri* or tentacles. The circular orifices of these tubes,—small holes perfectly round, with a white border,—had a curious appearance as we looked at the heart-shaped end of the valves. The discharging orifice, however, was but rarely visible; being usually closed, while the other remained constantly open. But these things were what we afterwards saw: for some time we could look at nothing but the magnificent foot, and the curious manner in which it was used.

The two lips of the mantle suddenly separate, and, gaping widely all along the front, recede nearly to the valves; while, at the same moment, a huge organ is thrust out somewhat like a tongue, nearly cylindrical, but a little flattened, and tapering to a point. Its surface is smooth, and brilliantly glossy; and its colour a fine rich scarlet, approaching to orange; but a better idea of it than can be conveyed by any description

will be obtained by supposing it to be made of polished cornelian. This beautiful and versatile foot is suddenly thrust out sideways, to the distance of four inches from the shell. Then, its point being curved backwards, the animal pushes it strongly against any opposing object, by the resistance of which the whole animal, shell and all, makes a considerable step forwards. If the Cockle were on its native sands, the leaps thus made would doubtless be more precise in their direction, and much more effective; but, cooped up with its fellows in a deep dish, all these herculean efforts availed only to knock the massive shells against the sides, or roll them irregularly over each other.

It was curious to notice the extent to which the interior of the Cockle was revealed, when the mouth gaped, and the foot was thrust out. By the aid of a candle we could see the interior surfaces of both valves, as it seemed, almost to the very beaks. I say, *as it seemed*, for so thin is the mantle where it lines the shell, and so closely does it adhere to it, that every character of the valves, whether as regards colour or irregularity of surface, was distinctly visible; and thus we are able to distinguish the species, not only by their external marks, but by one character drawn from the interior;—the ribs in *tuberculatum* extending only half-way across the valves, while in *aculeatum* they reach back to the beaks.

The former is much the finer species; the valves are more globose, and of a warmer colour; those that I have are even more spinous. The mantle is of a rich deep orange, with elevated ribs, corresponding to

those of the valves, of a yellow hue. These ribs of the mantle are visible in *aculeatum* also, but in *tuberculatum* they are much more strongly marked, both in form and colour. The siphons display the same orange hue as the mantle-lips, and have a finer appearance than in the other species; the interior of the orifices, in both, is covered with a layer of white pearly substance, almost luminous. In the foot of *tuberculatum*, which agrees in the particulars already mentioned with that of its congener, I observed a beautiful opalescent gleam, when under water.

I had supposed that they would display their instincts to more advantage if placed in circumstances more accordant to their habits. I therefore first imitated the sandy beach from which the tide has just retired, by laying my *protégés* on a bowl of wet sand; and afterwards placed them in a large vessel of seawater, with a sandy bottom of several inches deep. But in neither case was there any correspondent action in the animals; they did not attempt to burrow, nor were they so active as when in the clean dish. Most of them soon died; one only, a large specimen of *C. aculeatum*, lived about ten days, in the circumstances last mentioned, content to lie submerged on the top of the sand; though the siphons, mantle, and foot indicated health, until the last day or two of its life. Sickness is marked, in these animals, by the lax state of the mantle, which permanently recedes from the foot, and gapes; by the softness of the foot, which is partially protruded; and by the shrinking of the siphons.

A considerable number of those sent up, we "killed

to save their lives ; " making gastronomical use of them. The scalloped Cockles of Paignton we had known only by reputation ; we tried them in this way, and found them worthy of their fame.

Mr. Kingsley has favoured me with the following observations on the respiration of these species :— " Whether Mr. Clark be right or not in saying that the water is received through both siphons, he is right, against Mr. Alder and Mr. Cocks, in saying that it is expelled through both. What I see is this. From the small anal siphon, the water is expelled in steady periodic currents, forming a ripple (under three inches of water) several inches off. From the large siphon it is expelled seldom and capriciously, in a violent jet ; give ten a minute to the small, one in four or five minutes to the large. If disturbed, they commonly jet the water from the large tube.

" The large siphon opens periodically,—I think answering to the jets of the small siphon,—till it is quite circular. The small one almost always keeps an oval form : I can see no inward current in either. Clark is right in saying that they lie long without using the siphons ; sometimes they are not out for a whole day.

" What is the use of the fringes ? They cannot strain the water in so large an animal as this Cockle, which, when the siphon is open, has a $\frac{1}{3}$ -inch pipe fully patentous."

THE ROUGH SYRINX.

When once we have begun to look with curiosity on the strange things that ordinary people pass over

without notice, our wonder is continually excited by the variety of phase, and often by the uncouthness of form, under which some of the meaner creatures are presented to us. And this is very specially the case with the inhabitants of the sea. We can scarcely poke and pry for an hour among the rocks at low-water mark, or walk with an observant downcast eye along the beach after a gale, without finding some oddly-fashioned, suspicious-looking being, unlike any form of life that we have seen before. The dark, concealed interior of the sea becomes thus invested with a fresh mystery ; its vast recesses appear to be stored with all imaginable forms, and we are tempted to think there must be multitudes of living creatures whose very figure and structure have never yet been suspected.

“O Sea ! old Sea ! who yet knows half
Of thy wonders or thy pride !”

Yet so full and close has been the attention with which the naturalists of the last hundred years have studied the forms and affinities of organic existence, that all these strange beings find their place in the arranged systems of Nature ; and it is rare indeed to discover an animal or plant so diverse from those already familiar to us, that we are compelled to isolate it, or even to express uncertainty as to its general relations.

Among the treasures sent me by Mr. Kingsley was a specimen of the Rough Syrinx (*Syrinx nudus*), called by Pennant the Tube Worm. I presume it must be an unusually fine one of its kind ; for though it was my first acquaintance with the strange creature,

and I therefore have no data for comparison derived from personal observation, Professor Forbes gives its length as ranging from six to eight inches. My specimen, however, measured eleven inches in length, though the posterior extremity was contracted and the proboscis was but little everted, so that under other circumstances its length would certainly have exceeded a foot. The measurement was made, too, when the animal was at perfect rest, and not elongated by crawling. Its thickness was just $\frac{1}{8}$ ths of an inch, uniformly cylindrical, without any noticeable contractions or enlargements, except the swelling of the tail, and the diminution to form the proboscis.

The surface of the body can scarcely be called *rough*; for though it is reticulated, the skin is delicately smooth, glossy, and iridescent. The reticulations are produced by longitudinal and transverse lines, the former about $\frac{1}{2}$ th, the latter $\frac{1}{8}$ th of an inch apart, very regular. Both series are indented *striæ*, becoming evanescent by being pressed out, when the body is swollen or bent. The hinder extremity, for about an inch, is nearly smooth, forming a swollen oval sac, the furrows of both series being lost on its upper half in irregular corrugations. This part is pearly white, but the whole body besides is of a dull greyish buff, the skin reflecting opaline tints.

The anterior extremity is suddenly diminished into a proboscis of about half the diameter of the body, which is capable of being concealed within the body, or protruded by being turned inside out like a stocking. Prof. Forbes says its surface is minutely granulated, but this expression does not convey a correct idea of

its structure. It is densely covered with very minute triangular scaly spines, somewhat imbricate, the points of which are blunt, and are recurved. The resemblance borne by this organ to the proboscis in the parasitic Entozoa and Epizoa, is remarkable, and not only shows the affinity of the Syrinx to the vermiform classes, but suggests some analogy of purpose to which the spines are subservient. What the nature of the food is in the Syrinx, and what is the mode in which it is procured, I have no knowledge. I believe the subject is still *in tenebris*; but the stomach is said to be always filled with sand and minute fragments of shells, between the swallowing of which, and an elaborate prehensile array of recurved hooks, I certainly can imagine no connexion. The whole spinous surface of the proboscis is much more brilliantly iridescent than the body. The termination of this organ is said to be furnished with a circle of short digitate tentacles; but as the animal did not evert the proboscis to the full extent while I had it alive, I had no opportunity of observing these.

At a little more than an inch below the commencement of the proboscis there is a small tubercle, which I at first took for a wound, through which the intestine was protruding; but I believe it is the natural orifice of the digestive canal, which is said to be of great length, extending to the extremity of the body, and then turned on itself till it reaches this tubercle in its reverted course.

The animal was inert, scarcely moving, except when touched, and died after I had had it about a week.

THE TEREBELLA.

A rich fund of entertainment is very accessible to any one who can procure a few bits of weed-covered rock from the level of low-water. They need scarcely be selected ; with a hammer knock off a few points of the stones, of the size of a crown-piece ; the rougher, more leprous, more discoloured, in short, more *dirty*, the better. Put them into a globe of sea-water, an uncut decanter, or a wide-mouthed bottle, or, best of all, a confectioner's show glass, and let them remain, for a few hours. At night examine the sides of the bottle carefully with a pocket-lens, placing a candle on the opposite side. The multitude of curious little creatures that will have crawled out, and will be found mounting the walls of their prison, is quite surprising. Minute *Mollusca*, both bivalve and univalve, uncouth-formed *Crustacea*, tiny *Starfishes*, and especially *Annelida*, will pretty certainly reward the investigator. The last-named Class occurs in remarkable abundance and variety ; while if, after you have gone round the glass, noticing particularly the very edge of the surface-line, you pass your eye, assisted by the lens, carefully over the surfaces of the bits of stone, you will probably find many more creatures, such as tube-dwelling *Annelides*, the smaller *Zoophytes*, and several species of the delicate *Polyzoa*.

In a lot of sea-weeds sent up to me from the coast, enclosed in refuse-weed, and tightly packed in a piece of canvas, I found, among many such little things as I have described, a small *Terebella*, which interested

me by a habit that I should not have suspected in the genus. It is a worm closely allied to the *Sabellæ* and *Serpulae*, but having the head adorned with a great number of long thread-like tentacles, in place of the beautiful fans and other apparatus that distinguish those genera. In general the *Terebella* inhabits a tube, not formed of solid shell like that of the *Serpula*, nor of mud like that of the *Sabella*, but one most ingeniously fabricated by its own tentacles, built up of minute particles of sand or small fragments of shells, which it lays with elegance and neatness in a cement of its own construction. From the creation of the world this little worm has been practising the ancient and honourable craft of masonry, forming his vaulted tunnels of unhewn stones, (for what are atoms of sand but stones?) and bedding them with Roman cement, that "sets" under water. And hence I would respectfully suggest to the worthy brotherhood of Free and Accepted Masons, whether they do not injustice to themselves in tracing their origin no farther than Father Adam, since assuredly the *Terebellæ* were not only brethren but masters of the craft, before he began existence,—by a half-day at least.

If any of my readers should wish to see specimens of this ancient mason's art, nothing is easier than to gratify the desire. Go and turn over the loose stones that lie on the sandy shore along the line of low water, and you will find in sufficient abundance sandy tubes of the size of a goose-quill, and several inches in length, so brittle as hardly to endure removal, imbedded in the earth. These are the habitations of *T. chrysodon*, most commonly empty and deserted;

but not infrequently the long slender tentacles of this species, like orange-coloured animated threads, may be seen twining in all directions over the exposed soil. If you carefully look at the larger end of the tube, you will observe that it is irregularly fringed with threads of exactly the same texture as the tube itself; they are, in fact, minute tubes of the same shelly mosaic, though no thicker than stout sewing cotton, and most admirably constructed to sheath the tentacles, as they project from the main tube, and expand on every side.

But it was not as a builder that I was going to introduce to you my little *Terebella*, that the candle revealed in the vase of sea-weeds, when I examined them the evening after their arrival. It was a little creature, not quite an inch long in the body, and with tentacles expanding about as much. Whether, finding itself in new quarters, it had left its dwelling to explore the neighbourhood, I know not,—possibly, by careful search, I might have found the emptied tube among the bases of the tufted weeds, or adhering to some of the pieces of stone on which they were growing;—but the naked worm was deliberately mounting the smooth side of the tall glass vessel. The body hung down, and the tentacles, some fifty or sixty in number, were spread out on each side and above, on the surface of the glass, adhering to it evidently, and alternately elongated and contracted, with an impatient, writhing, twisting action, the result of which was to crawl, not very slowly either, up the glass.

After a time, I went into the room again, and found the *Terebella* in another situation, and performing a

new feat ; one even less to have been anticipated than the perpendicular wall-climbing I have described. It was now swimming on the surface of the water, or rather *creeping along the inferior surface of the incumbent stratum of air* (for that is the true expression of the action), as every one has observed the Pond Snails (*Limnaea*) to do in summer, and as the Nudibranchs and many other Gasteropod Mollusca do also. It was interesting to see how much at home the little worm was at this performance ; I doubt not he had enjoyed the fresh air in the same manner many a time ; his body depended perpendicularly, while the thread-like tentacles were spread over the surface, wriggling and twining *more suo*, but advancing along the halcyon sea so evenly, that in about an hour after I saw that he had gained the opposite side of the bounding glass, a distance of about five inches.

THE GOLDEN-COMBED WORM.

These tube-forming Annelida are very interesting creatures ; and many of them possess great beauty, from the exquisitely delicate and often highly-coloured appendages with which they are furnished. Through the kindness of the Rev. C. Kingsley, I possess a full-grown specimen of the Golden-combed Worm (*Amphitrite auricoma*). When I at first had him he was very shy and timid, but after a week or two he grew more familiar, and would protrude his gilt combs, and carry on his avocations, as if quite at home. At first all that was to be seen was a tube formed like a rounded obelisk, or a factory chimney ; being about

one-third of an inch in diameter at one end, and gradually tapering to one-fifth of an inch at the other, whence it abruptly terminated in a short cone, perforated in the centre. The whole length was an inch and a half, and its texture was that of an elegant mosaic, composed of grains of fine sand of various colours, and excessively minute fragments of shell, agglutinated together so as to be pretty strong, though not more than one grain thick. It was only with a lens that this structure could be seen ; to the naked eye it seemed an uniform substance, slightly rough, and of a pale red hue, dotted with black.

On looking into the larger end of this tube, I could see what looked like a stopper of white flesh, exactly fitting the calibre, and moving up and down in the tube like a piston. Occasionally it was protruded a little beyond the edge, when its extremity was seen to be truncate, or, as it were, cut straight off, so that it was just like a cork that moves freely up and down in the neck of a bottle. But from the summit of this fleshy cork two organs were projecting, each of which exactly resembled a lady's *back comb*, the teeth being curved in the same manner ; only we must suppose them to be bevelled off on each side, the central teeth of each comb being much the longest ; their surface is highly metallic, reflecting the light exactly like burnished gold. These two combs are placed side by side (or edge to edge), so that together they extend nearly all across the flat end of the "cork ;" not, however, in a straight, but an angled line, so as to cut off about 120° , or one-third of the circle.

When the creature had overcome in some degree

the timidity induced by its novel circumstances, such as the increased light, the slight depth of water, the heightened temperature, &c., it was interesting to watch its proceedings, especially at night with a candle; as then it was more active. I had put it into a vase of water with two inches of fine siliceous sand for a bottom, on which the tube lay along. After a few tentative essays, it grew bold enough to thrust out its cork-like head, projecting the combs as it did so, so as to show more of their bases. They thus separated from each other, and each assumed the form of a concave fan, or of a turkey's tail were the shafts of the feathers stripped of the vanes.

Their use was now apparent. The animal is a burrower in sand; I repeatedly lost it during my absence from the room, and found it plunged to the very bottom. Its mode of burrowing is as follows:—If the animal is not lying rightly, it turns on its axis within the tube (which it can do with perfect facility, as there is no organic connexion between its body and its dwelling, as there is between the Mollusk and its shell), until the third of the circle enclosed by the angle of the combs is next the surface. These organs are now thrust outwards and downwards, so that their points enter the soil like shovels; then, by muscular movements of the head, they are lifted upwards and backwards, carrying in their concavity their load of sand, which they throw over the upper margin of the tube, behind the head. The combs, or, as I may now call them, digging-forks, immediately make another plunge, and deliver their spadeful of sand in like manner. A considerable hollow is presently formed,

which a number of thread-like filaments protruded from the lower part of the head are engaged from time to time in feeling, and apparently examining. When this hollow is sufficiently wide and deep, the animal tilts its tube into it, by protruding until the weight of its body overbalances the supported part ; it proceeds with its excavation, the tube becoming more and more inclined, until at length it is brought to the perpendicular, when it descends straight down till it is completely buried, the sand closing over its disappearing extremity.

This burrowing habit, the mouth of the tube being downward, makes it needful that there should be a posterior orifice to the tube. All the tribe to which this species belongs are nourished by those minute organic atoms which are held in suspension by the water, and which are brought by strong ciliary currents to the mouth. The currents thus produced are subservient to the two functions of respiration and digestion, the water thus hurled along giving off its oxygen to the gills, and its organic atoms to the stomach. The refuse water, kept in unflagging motion by vigorous cilia, is poured from the terminal extremity of the body, and discharged through the minute orifice that I have described.

Dr. Williams, in his admirable " Report on the British Annelida," has, I think, fallen into an error with regard to this species ; or at least his statements in this particular do not agree with my own observation. After describing the mode in which the posterior extremity in *A. alveolata* is contracted into a true cylindrical tail, which, turning upwards, returns

along parallel to the body, in order to project the faecal refuse to the anterior extremity of the tube, he ascribes a similar structure to the present species. "In *A. auricoma*," he observes, "the tail-like appendage to the inferior extremity of the body, in all respects but one, is formed on the model of that of the former species. One labium of the terminal orifice is here extended into a flap-like process, which, by a sudden act of muscular contraction, imparts a smart blow to the faeculent mass as it escapes from the intestine, and thus effectually conveys it to the upper outlet of the tube." (P. 208.) Again, in treating of the alimentary system of the genera *Serpula*, *Sabella*, and *Amphitrite*, he remarks that "it is through the agency of the water-current that traverses the whole interior of the body, that the faeculent refuse is projected from the bottom to the upper orifice of the tube, and that the habitation of the worm is maintained in a state of never-varying cleanliness and purity." (P. 225.)

I am absolutely certain, however, that in my specimen of *A. auricoma* the discharge is terminal. As the animal lies on the bottom, a stream of water issues from the hinder end of the tube, not constant but intermittent, by which the adjacent sand is driven away with force, forming a furrow, a third of an inch long, extending from the end of the tube. The terminal portion of the tail itself is occasionally protruded through the aperture, and moved round with agility. When the tube with the contained animal is removed from the water and again replaced, a bubble of air escapes from the posterior orifice; and when the

tube alone (the animal having deserted it) was held up full of water, the fluid ran out rapidly at the same aperture. The animal, also, which voluntarily crawled out of its habitation, displays no such reversion of the tail as is described by Dr. Williams. This organ is a little leaf-shaped body, formed by the union of several short segments, and slightly bent downward, but not reverted.

The quitting of its tenement by the Worm enabled me to see and admire some other points in its structure, and their subservience to its economy. On each side of the neck, just below the edge of the flat, cork-like head, are seen two little scarlet gills, resembling in structure those of fishes. Each consists of a free leaflet, formed of numerous thin plates set face to face: in health these little pointed gills are thrown about with agility in various directions, and their points alternately coiled up and unfolded. Behind these, along each side of the body, are placed prominent, fleshy warts, to the number of fifteen pairs; each of which consists of two portions, the hinder part being dilated into a soft transverse mop, and the fore part perforated to give exit to a brush of fine spears of elaborate construction. They are about twelve in each bundle, each formed of a long and slender, highly elastic, glassy shaft, terminated by a bent blade, the edge of which is of the most delicate thinness, and the point of which is drawn out to great length and tenuity. Some of the blades appear to be simple and knife-like, but others have the edge cut with oblique slits, parallel to each other, and pointing from the base. They do not form saw-teeth, but are

merely straight slits. The bundle of lancets can be protruded at will to a considerable length, or withdrawn into the fleshy wart so as to be quite concealed, as in a sheath. Their direction is backward, and their main use is, doubtless, that of catching against the internal walls of the tube, and pushing the animal outwards. At the same time it is not improbable that their cutting edges serve to cut and dress the fragments of sand of which the tube is composed; and that the spongy cushions behind the bundles help to bring the work to that state of polished smoothness, which is needful to guard the soft and tender body of the Annelide from annoyance.

SUICIDE.

Some time ago a humorous periodical favoured the public with a portrait of "a Prime Minister a-bolishing of his self." The marine naturalist is aware that the process is occasionally exhibited by other animals also; the faculty may perhaps be the link, which in a quinary arrangement connects the Prime Ministers with the Echinoderms. Certainly the latter possess this useful faculty in extraordinary perfection, as witness the triumphant way in which *Luidia fragilissima* laughed at Professor Forbes.* A swell gentleman in Regent Quadrant could not have "done" a police officer in more admirable style.

The Brittle-stars (*Ophiocoma*), as their name imports, are considered peculiarly prone to this suicidal work; but, for my own experience, though I have

* Brit. Starfishes, p. 138.

dredged a tolerable quantity (I say "quantity" because Brittle-stars come up in pecks or bushels rather than in scores or hundreds), and have had plenty of examples of disjointed members, I have never found it prevail to such an extent as to prevent my preserving almost with certainty any specimen I wished, without particular precautions. And certainly they are charming occupants of an Aquarium: the extreme variety of colouring displayed by them,—I speak of the most abundant species, the Rosette (*O. rosula*),—and the gorgeousness of the hues frequently presented; orange, yellow, crimson, purple, blue, white; often arranged in alternate angular bands; catch the eye of the most indifferent in a moment: while the exquisitely sculptured spines that profusely fringe each ray, and the many-sided and variously-formed, but perfectly regular and symmetrical scales and plates, that clothe the disk and the rays on both surfaces, elicit our admiration when we examine them more closely. (*See Plate IV.*)

Professor Forbes is "doubtful, however, whether *Uraster* (the common Starfish, Crossfish or Five-finger) has the power of throwing off its rays voluntarily, as is the case with *Luidia* and the *Ophiuræ*." I have had evidence that it has, and that not in the case of *U. glacialis*, in which species these organs are acknowledged to be fragile, but in the Common Crossfish (*U. rubens*).

A specimen of this latter, about five inches in diameter, that had been dredged in Weymouth harbour, was crawling tranquilly up the glass side of my large tank. Several hours had elapsed since it was put in,

and it had appeared quite at home, and was as lively as could be desired. It had three full-sized rays, and two very small ones, doubtless reproducing. Suddenly, without any apparent provocation, it threw off one of the large rays. I did not see the process, but I had looked at it a moment before, and at the next glance the patient was marching calmly on as before, with one of his legs an inch behind him. *The suckers of the rejected ray were still as active as before*, alternately loosening their hold and adhering, just as before; *but there was no advance*.

Seven hours afterwards, when I retired to bed, the suckers of the ray were still moving, and the ray maintained its adhesion to the perpendicular side of the glass; as it did also when I got up the next morning. But by this time three more rays were separated, and were adhering by their suckers to the upright glass just where they had been left: while the body pursued its solitary journey, solaced by the fidelity of its sole remaining ray,—one of the large ones.

My curiosity had been excited by the fact that I could not determine with certainty the point from which the first rejected member had separated. I examined the animal minutely, but so entire seemed the whole skin, and so equi-distant the remaining rays, that I could not satisfy myself, though I returned again and again to the scrutiny. I did not, however, choose to handle the animal much. But now that so many limbs were gone, the points of separation were just visible; yet the contraction of the surrounding parts was so great that the wounds were exceedingly small. The separation was in each case exactly the

same, by an oblique cut, as it were, upward and outward, close to the body; and perfectly clean, without laceration, and without any perceptible flow of liquid.

I carefully slit up with scissors one of the separated rays, and found within it the bulbs of the numerous suckers, of course, and the two *cæca* of the intestine, beautifully arborescent, and of a yellowish olive colour; so that, in the voluntary throwing off of a limb, these digestive organs are not absorbed or contracted into the body, but cast off also.

The Starfish continued to walk about, like a Chelsea pensioner, on his one leg, till the afternoon of this second day, when the remaining limb dropped off by its own weight, on my lifting the animal from one vessel to another. I took great care of the body, hoping that it might reproduce the lost limbs while in my possession. But I was disappointed. It never moved after this last amputation, and putrefaction soon made it too manifest that death had ensued.

The *Holothuriæ*, or Sea-Cucumbers—those members of the Class *Echinodermata*, which, to the locomotive suckers and other essential organs of the Starfishes and Sea-Urchins, conjoin some peculiarities, such as the elongate form, and a circle of oral tentacula, which are considered to approximate them to the Worms (*Annelida*), or, perhaps more truly, to the *Actiniæ*—usually commit suicide in a different manner. According to the concurrent testimony of observers, they frequently disgorge from the mouth, the stomach, intestines, and ovary, “leaving the body an empty sac;” and occasionally throwing off even the tentacles, the mouth, and the dental cylinder. But some species

of these are said to "divide spontaneously through the middle into two or more parts, all becoming ultimately perfect by the development of new organs." *

This spontaneous division I lately had an opportunity of witnessing in an Echinoderm of great rarity, so rare that I know not whether any British zoologist has seen it before, since its discovery on the South Devon coast by Montagu. Professor Forbes says he had never met with a living example. I allude to *Chirodota digitata*.

Many living specimens of this species were forwarded to me by the kindness of the Rev. C. Kingsley, who obtained them in the vicinity of Torquay. He says, "I got this and *Actinia chrysanthellum* † in two contiguous coves, washed up after a heavy gale [in January] in company with *Lutraria elliptica*, and the common red hag-worm, indicating life on a mud-sand bottom."

This animal is a very worm-like *Holothuria*, nearly cylindrical in form when in health. The largest of my specimens extended to ten inches, with an average diameter of one-fourth of an inch. The posterior extremity is always plump and rounded, sometimes swollen to an oval sac, half an inch in diameter and two inches long. The body is covered with annular striæ, most distinct on the fore half.

Notwithstanding the cylindrical form, a dorsal and a ventral side may be readily distinguished. The former has, as its general colour, a hue approaching to the *Indian-red* of artists, while the latter is of a pale pellucid flesh-colour. The body is marked by

* Dalyell.

† *Peachia hastata* (mihi).

five longitudinal colourless lines, of which the dorsal ones are only half as broad as the ventral. Under a lens the ground colour is resolved into a number of minute red dots, thickly placed dorsally, and often becoming confluent into longitudinal dashes, but placed thinly on the belly.

The anterior extremity forms a disk surrounded by a marginal circle of twelve short tentacula. These organs are rather thick columns, *with their bases in contact*, tapering to the tip, where each branches into four short diverging fingers, which are likewise taper and pointed. The red speckling extends up the tentacles. The mouth is a cup-shaped circular cavity, whose edges reach to the bases of the tentacles.

The dental cylinder of the *Holothuriæ* is represented by a slender ring of minute white calcareous pieces, varying in size, and irregular in form. None of them are larger than $\frac{1}{25}$ th of an inch square. They are united by cartilage into an elastic ring, running round the base of the tentacular circle.

While in captivity the motions of these animals were quite vermicular, slowly twisting the long body into knots and contortions, and writhing about. The tentacles were now and then bent inward to the mouth, one or two at a time, and then unfolded. They did not long retain the cylindrical form in which I received them; very soon one after another began to constrict the body into knobs at irregular intervals, occasionally so forcibly as to separate into two or many pieces. Sometimes the division was incomplete; so that the intestines, and especially the long generative threads, were forced out abundantly from

the constriction. But these latter must be described particularly.

Each of the animals, as soon as it had arrived at this stage of its suicidal process, was seen to be wrapped up in a swathing-band of white threads, which, issuing in a bundle from the rupture, soon became involved in inextricable confusion by the writhings and knottings of the animal. The threads were of great length, and closely resembled in appearance white sewing-cotton. The microscope revealed their structure. They were not ciliated, and therefore had no spontaneous motion ; in these respects differing from the convoluted filaments of the Actiniæ, to which they bear great affinity. The common texture was composed of a multitude of very minute round granules of hyaline and nearly colourless jelly, about $\frac{1}{5000}$ th of an inch in diameter, having no motion when crushed down. In this granular substance were set numerous ova, ranging from $\frac{1}{195}$ th to $\frac{1}{250}$ th of an inch in diameter. These consisted of a hyaline integument, including an opaque brown granular yolk, sometimes nearly filling the interior, at others occupying not more than two-thirds of it. Within the yolk in each there was a well-defined, globular, hyaline nucleus. On continued pressure, the integument burst with a start and a loud crepitation ; the yolk oozed through the rupture, retaining its integrity, though its elastic form changed as it passed through the narrow aperture : the nucleus was also compressible and elastic, escaping entire, a clear globular vesicle.

I was in hopes that this spontaneous protrusion of the egg-tubes was a normal process, and that by

keeping the animals I might witness the development of the eggs and young, especially after what Sir John Dalyell and others have observed in the *Holothuriæ*. But I found that the self-divided animals very soon became offensive and evidently putrescent, an infallible evidence that death had ensued ; and that not only was this the case with the posterior portions separated from the main body, but with the latter also, or that to which the head was attached. It is possible that the whole process was caused by morbid muscular contraction, arising from the stimulus of unnatural circumstances. Mr. Kingsley suggests to me that "the animal breaks itself up from the irritation of *light*," a suggestion highly probable ; and that "we must keep it in the shade if we obtain it again."

One which I put into fresh water, in order to kill it for preservation, immediately began to contract, and continued the process (not rapidly) to rigidity. It then lengthened again, distended the posterior extremity, and then divided by constriction near the middle, protruding the intestine, but no ovigerous threads. The body, after lying a while, discharged a stain, which diffused itself to some distance through the water, and precipitated a subtle sediment of a brilliant gamboge hue, which increased to saffron. The whole water in the saucer was, *besides*, slightly tinged with pink. The specimen, on being immersed in a preservative fluid—a solution of acetate of alumina and sulphate of potash—tinged the lower part of it with a rich transparent crimson, a little inclined to purple, the hue of which was deepest near the bottom.

The vermiform figure of this animal, its swollen posterior extremity, and its tendency to irregular constriction, combine with the absence of suckers, and the deterioration of the oral tentacles, to mark its affinity with the *Sipunculidae*, in which family I think it should be placed. I know the characters of the genus *Chirodota* of Eschscholtz, only from their citation in Professor Forbes' "Star-fishes," but cannot help thinking, with Montagu, that our Torquay specimens come very close to Müller's *Holothuria inhaerens*, judging from the figure and Latin diagnosis of the latter; for unfortunately I cannot read the Danish language. The only difference I notice is in the form of the tentacles, Müller's species having each sixteen terminal digitations, while ours has but four.

THE PHYLLODOCE.

Many of the Marine Worms, as I have before said, are very elegant creatures, and not a few present us with great variety and brilliance of colours. Pre-eminent among them are the Leaf-worms, according to the verdict of most who have studied this Class of beings, from Fabricius downward, who styled them "Virgines pulcherrimæ inter Nereides." In the little shallow hollows that are to be found on the surface of the rocks covered at high tide, green with the puckered leaves of the lettuce-like *Ulva*, and affording a happy home to multitudes of Purples, Periwinkles, Tops and Mussels, we may often see, gliding in and out, the worms of this genus, which the indefatigable Savigny named after the sea-nymph Phyllodoce:—

"—— Phyllodoceque
Cæsariem effusæ nitidam per candida colla."—VIRGIL.

These Worms bear a general resemblance to the Centipedes of the land, and some may behold them with aversion on that account; but, prejudice being laid aside, we must confess that their forms are elegant, their motions lithe, easy, and full of grace, and their general appearance attractive. They are distinguished by their long, slender, and flattened bodies, composed of very numerous segments, sometimes amounting to several hundred (as in the case of *Phyllodoce laminosa*, Sav., found on the French side of the Channel, which reaches to two feet in length, and is divided into more than 500 segments *); but they may be more readily recognised by the series of overlapping leaflets which run along each side, one pair to each segment.

It is a very curious spectacle to see these Worms turn the stomach inside out. In common with most other genera of this Class, the head is minute, and what seems to be the mouth is but the orifice from which the proboscis is protruded. In the genus Phyllodoce, this organ is a great muscular sac, sometimes as much as one-fourth of the whole length of the body. The beholder is astonished to see a chasm in the under side of the head begin to yawn, and the interior rapidly protrude, turning inside out as it comes forth, like a living stocking, until it assumes the form of an enormous pear-shaped bag, the surface of which is beset with a multitude of secreting warts or glands, like those which stud the tongue in higher animals. In many genera the extremity of this

* Aud. et M.-Edw.; Litt. de la Fr. ii. 223.

stomach, throat, or proboscis, is furnished with a formidable apparatus of horny grasping jaws, variously modified into teeth, hooks and knife-blades, for seizing, tearing, and cutting prey; but in *Phyllodoce*, there are none of these, the elegant animals feeding probably on the fluid juices of dead animals, or on their soft parts, which need no violence. The very tip, however, which of course is perforated, is surrounded by a muscle, by means of which it contracts forcibly on whatever it is applied to, and thus holds it firmly while the inversion of the sac drags it into the body to be digested. The disappearance of the organ is as astonishing as its extrusion; beginning at the tip, which is quickly turned in, the whole rapidly returns to its cavity in the same order as it came out, and then we wonder how so enormous a proboscis can be enclosed in so slender a body.

There is a species of this genus, very common in the situations I have mentioned, named *Ph. lamellicera*; which is of a yellowish-green, sometimes verging to an olive hue. But a much more beautiful kind has been sent me alive from Torquay, by the courtesy of Mr. Kingsley, who found it beneath a stone, at the edge of the laminarian level. I can find nothing corresponding to it either in Audouin and M.-Edwards, or in Dr. Johnston's papers on the British Annelida, and shall therefore describe it under the appellation of *P. marginata*.

Its length varies from five to three inches, according as it is elongated or contracted; the body is composed of about 170 segments, nearly of equal diameter throughout, and abruptly rounded at both extremities.

The segments are bordered by oval, puckered leaflets, the colour of which, being almost black, with an edging of light yellow-green, gives the animal a most beautiful appearance, somewhat resembling that of a number of black velvet palls with their light fringes. The central part of the back is of a steel-blue, changing under the play of light to purple, with a highly metallic reflection. The under surface is of an opalescent grey.*

The beauty in a great measure disappears on immersion in a preservative fluid. On the first touch of the solution I employ, Acetate of Alumina, a fluid was poured out copiously from all parts of the animal, which diffused itself, first as a lively green tint, then becoming yellow, which in about an hour became a warm orange-brown, quite transparent, and without precipitation.

The various kinds of spears which are grouped into pencils, and placed along the sides of most of the animals of this Class, are among the most exquisite productions with which the naturalist is conversant, and show forth, in a more than ordinary degree, the delicate and inimitable skill of the Divine handiwork. In this animal they are less complicate than in some of which I have had occasion to speak; still, under a high microscopic power, they are well worthy of admiration. In order to understand their arrangement, let me say, that each segment of the body is

* From one or two specimens that have since fallen under my notice, I have reason to conclude that this species is identical with *Phyllodoce Paretti*, of which a fine figure is given in the commemorative edition of Cuvier's "*Règne Animal.*" (Second Edition.)

produced on each side into a little conical wart-like foot, on the upper side of which is attached, by a short footstalk, the beautiful pall-like leaflet, and on the under side a similar smaller one, the tip of the foot projecting between them. This point is perforated to give emission to the pencil of bristle-spears, which are arranged like a fan, and are, at the will of the animal, projected to a considerable length from the foot, or withdrawn completely into its interior, as into a sheath. Each individual bristle is composed of a very slender, long, straight shaft, terminating in a knob, somewhat resembling the end of a limb-bone. This is slit in one direction to receive the terminal lance-head, which is fitted into it exactly as a knife-blade is fixed into its handle. It is in fact a knife-blade, having a thickened back, and a very thin edge, which is notched with teeth of the most delicate subtilty. The blade is slightly curved, and drawn out to a long acute point; and the whole space is formed out of a substance that rivals the purest glass.

The full use of these most exquisitely contrived and finished organs is, I think, yet to be discovered. They are doubtless instruments of locomotion, being evidently used to push the animal along, as a ferryman propels a boat with his pole; and the saw-like teeth may serve to catch the roughnesses of the surfaces along which it is moving. It is possible also that they may be weapons of defence; for, being thrust out at every lateral undulation of the segments, they present formidable *chevaux de frise* to any small enemy who may entertain malice prepense against the

Annelid. Still the situation of these arms is hardly such as we should expect, if this were their primary object; and the elaborate construction of their jointed blades seems contrived for some use more delicate than that of a shoving-pole. Perhaps my readers may expect that I have some suggestion to make, but I am sorry to say I have not. I have not been able to discover any function that these elegant and exquisite implements possess in addition to those just mentioned, though I have little doubt that such function is to be discovered. It is a common phenomenon for the same organ to have two or more distinct and separate uses. The human tongue and palate play an important part in tasting food, and preparing it for swallowing, and also in the utterance of speech; and in the worm before us, the beautifully-painted leaflets are organs of respiration, the blood (or rather, according to Dr. Williams, the peritoneal fluid) circulating through them in spacious radiating canals, and receiving oxygen from the currents which the marginal cilia perpetually impel across their surface; but they are also organs of locomotion; waved through the water, and half-turned when the stroke is made,—as the waterman "*feathers*" his oar—it is easy to see that the animal is actually *rowed* along, like one of the galleys of the ancients, with a bank of three hundred oars. "Natare valet lamellis suis retroversis, oblique sursum erectis,"—observes Fabricius of these elegant animals.

The following observations, whose beauty and truth necessitate no apology for their quotation, are made by one who is perhaps better qualified than any one

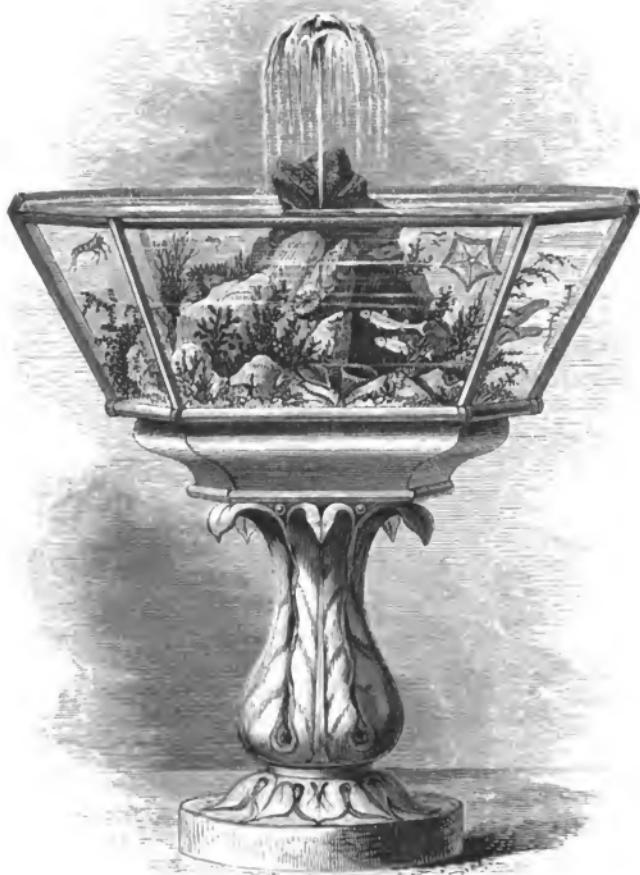
else to express a judgment on these creatures, from the care and labour which he has bestowed on the study of them.

" It is not easy to express the pleasure which is excited in the mind of the observer of nature, while contemplating the habit and manners of the Annelida. Every movement exemplifies the curve of beauty ; every tentacle winds ceaselessly and rapidly through a thousand forms of matchless grace. Whether coiling round a visible object, or picking up a microscopic molecule for the construction of the cell, it exhibits a delicacy and precision of aim, which the erudite finger of the most skilful artisan never equalled. The refined precision of its muscular performances, is matched only by its exquisite sensibility. Like the human hand, of which the manifold endowments have exhausted the admiring eloquence of philosophers and theologians, it unites in its little self the most varied capacities. It is at once an eye, an ear, a nose, and a finger : it sees, it hears, it smells, it touches. Leading for the most part a subaqueous or subterranean life, the sense of sight in the Annelid is little required : and gifted in every part of the body with a superlative tenderness of touch, the sense of hearing is rendered unnecessary. Anatomy accordingly demonstrates only the obscurest rudiments of an organ of vision, while that of hearing has eluded the scrutiny of the minutest examination. Is it not to be marvelled at, that these humble beings should see without eyes, and smell without a nose ? It is not affirmed that this is literally and entirely true ; but it is exact to a degree enough to prove the wondrous manner in

which the sense of touch is made to supersede all the other senses.

"Whether progressing on the solid surface, or moving through water, or tunneling the sand, advancing or retreating in its tube, the Annelid performs muscular feats, distinguished at once for their complexity and harmony. In grace of coil the little Worm excels the Serpent. In regularity of march the thousand-footed Nereid out-rivals the Centipede. The leaf-armed Phyllodoce swims with greater beauty of mechanism than the Fish, and the vulgar Earth-worm shames the Mole in the exactitude and skill of its subterranean operations. Why, then, should 'the humble worm' have remained so long without an historian? Is the care, the wisdom, the love, the paternal solicitude of the Almighty not legible in the surpassing organism, the ingenious architectures, the individual and social habits, the adaptation of structure to the physical conditions of existence, of these degraded beings? Do not their habitations display His care, their instincts His wisdom, their *merriment* His love, their vast specific diversities His solicitous and inscrutable Providence?" *

* Dr. Williams's "Report on the British Annelida," p. 271.



THE FOUNTAIN AQUARIUM.

CHAPTER XI.

Let us visit the caves of a miniature ocean,
The gorgeous sea-flowers and worms to behold :—
Actinia, rose-finger'd, ever in motion ;
Phyllodoce, liveried in emerald and gold.

No music is heard in these silent recesses,
Save such gentle notes as the Eolids utter ;
But fair Aphrodite waves gem-spangled tresses,
And Scallops, like butterflies, merrily flutter.

Here a Sun up the crystalline pathway is clambering,
Blood-hued as his rival who sinks in the west ;
Bright Stars in their devious courses are wandering,
Where the Blenny peeps forth from her well-woven nest.

These forms from the sunny South surely have wander'd ;
Anomia the pearl of the orient mocks ;
Bold Dragonet, jewel-mail'd, hoists his tall standard,
And crimson-clad Labrus darts under the rocks.

How softly the feathery sea-groves are waving !
Their plume-tufts of purple, and scarlet, and green,
The pure and clear element gently is laving ;—
While tiny swarms merrily sport them between.

How glorious, O Lord, are thy works of creation !
How fit to abase us, and humble our pride !
Not alone would we gaze with devout admiration,
But adore thee, obey thee, and love thee beside !

PRACTICAL INSTRUCTIONS.

THIS Chapter is like the postscript of a lady's letter ;
though placed last, it contains the most important
part of the volume. I intend it to afford such assist-

ance to those who intend to keep marine animals and plants, as my experience and inquiries enable me to furnish: and therefore I shall arrange the details in such an order as shall be most easy of reference.

THE NAME.

A neat, easily pronounced and easily remembered, significant, and expressive term is so advantageous, that it is worth taking some trouble to select the best. For the subject of this volume some have chosen the word Vivarium, and I have myself occasionally used it. The only objection to it is that it lacks distinctness of signification. It literally means any enclosure in which living animals are kept; and the ancients used it to signify a park, a rabbit-warren, and a fish-pond; indeed, I am not sure whether our word "warren," is not "Vivarium" Saxonised. Thus it is quite as applicable to the whole Zoological Garden as to any particular house, yard, or tank in it.

To avoid this indefiniteness, others have used the term Aqua-vivarium. The objection to this is its awkward length and uncouthness, which render it unsuitable for a popular exhibition or domestic amenity.

I have adopted the word AQUARIUM, as being free from the objections which lie against the other two, while it possesses the neatness of the former, and the definiteness of the latter. The term had already been in use among the botanists, to designate the tanks in which aquatic plants were reared; and the employment of the same term for our tanks is not forbidden

by the character of the service to which they are put, since this is not an alteration, but only an extension. The growth of aquatic plants is still a most important and pleasing feature of our pursuit, and the addition of aquatic animals does not at all detract from the appropriateness of the appellation. Let the word AQUARIUM then be the one selected to indicate these interesting collections of aquatic animals and plants, distinguishing it as a Freshwater Aquarium, if its contents be fluviatile, or a Marine Aquarium, if it be such as I have made the subject of the present volume.

THE TANK.

FORM, SIZE, AND MATERIALS.—So much depends on individual taste and means in this respect, as well as on the situation which the Aquarium is intended to occupy, that no rule can be laid down for dimensions. My largest tank (now in use as a *fresh* water Aquarium) is a parallel-sided vessel, two feet long, one-and-a-half foot wide, one-and-a-half foot deep; the sides and ends of plate-glass, three-sixteenths thick; the bottom, a slab of slate one inch thick; the corners of birch-wood, turned into pillars, each surmounted by a knob, and united by a frame-top or bar, going all round. The glass is set in grooves in the slate and wood, and fastened with white-lead putty. I have two others, agreeing with this in all respects, except in dimensions, the smallest being (in the clear) fifteen inches long, twelve inches wide, and twelve inches deep. This is a very neat and pretty object for a parlour table, and will hold at least fifty

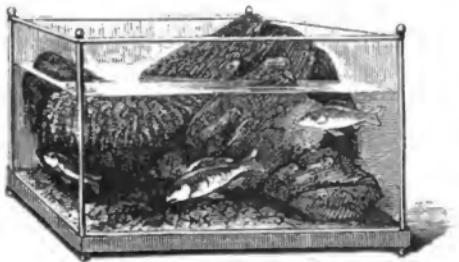
animals appreciable to the senses, provided they be well selected, and a sufficient growth of plants established.

I have also another tank with a sloping back, made on Mr. Warington's plan. It is of zinc, with the back and two sides of slate, the front and two front-sides alone being of glass. Its form is six-sided, the front resembling a bow window; it is three feet long by one foot ten inches in greatest width, and the same in depth; the peculiarity is that the back slopes inward, so that the bottom is but eight inches wide. I cannot commend this form; its appearance is lumbering and inelegant; the opacity of the back and sides throws the interior into a degree of darkness, (even though placed in a south window,) which greatly impedes observation; and I cannot see, by comparison with my others, which are of glass all round, that the advantage anticipated, of admitting the light only from above, is real, or at least of sufficient importance to compensate the uninviting gloominess alluded to. Its depth also is too great; a foot of water is as much as is needful for a parlour Aquarium.

The tanks at the Zoological Society's Gardens are constructed by Messrs. Sanders and Woolcott, of Guilford Street. They make Aquaria from eight feet in length to sixteen inches, and either with all the sides of glass, or with slate ends. The bottom is of slate, and the frame-work of iron. Their tanks are excellently made, and their prices reasonable. The engravings on the opposite page represent some of their forms.



OCTAGONAL TANK.



RECTANGULAR TANK.

A novel mode of constructing tanks has been suggested to me by Mr. W. Dodgson, of Wigton, Cumberland, which, as I have not tried it, I will describe in his own words :—

“ I have lately been constructing two Aquariums ; and as the way in which they are made may be new and perhaps useful to you, I take the liberty of communicating it. Slate we have no opportunity of procuring in suitable pieces for joining, and our stone is too porous for the purpose. I therefore got the bottom and two ends made in one piece out of the yellow clay used for garden vases, chimney-tops, and other coarse pottery, and found it answered exceedingly well and has several advantages.

“ Partly as a means of supporting the ends, but principally to form artificial rockwork and shelter for the animals, the two ends are buttressed inside with very rough pieces of clay, put on so as to leave plenty of holes and fissures ; the fire fastens these firmly together and makes them as hard as stone. Grooves are left along the bottom, and up the two ends, for the glass to fit into. The outside is relieved with ornamental work. Cheapness is a great recommendation ; the pot being charged 1*d.* or 2*d.* per hundred cubical inches, according to the amount of ornament. I should think your London potters would make something very neat, and the mould once made, they could be supplied very cheaply ; and considering their freedom from leakage and their strength, I think they would prove as satisfactory as any kind of cistern. Mine are about three feet long, and thirty inches high and broad, holding thirty gallons each. I bed the

glass with white lead, leaving about a quarter inch in depth of the groove unfilled. When the putty is set, I fill it up with shell-lac dissolved in naphtha and made into a paste with whiting. This sets very quickly ; and, hard as stone, is quite insoluble, and prevents the water from coming in contact with the lead, which I think must constantly be giving off small quantities of oxide."

In reply to some inquiries of mine, the same gentleman writes me further as follows :—

" I have delayed replying to you respecting the price of pottery for Aquariums till I had an opportunity of seeing the party who made mine. The price of one such as you name would be 6s. or 8s., but, as it would weigh four hundredweight, the carriage to London would be quite as much. He was rather doubtful whether with his coarse clay he could make one the length you name to hold together ; as two or three of mine, which were shorter, separated in the middle when being burnt, from the great weight of the ends preventing the centre contracting regularly. He thinks your best plan would be to get one of the terra-cotta workers to make one, which he thinks he would do more cheaply than it could be sent from here ; and their clay being finer, a much neater article could be made. It would be well to be on the spot, and see the rough clay put on the ends, as workmen in general have not much idea of what is required.

" To prevent the water filtering through the pots, mine were well glazed inside with flint-glaze, free from lead. Probably it would be better to glaze the outside, and leave the inside porous."

If a cylindrical form of vessel be preferred, it can be obtained without any material but glass in the construction. A very pleasing aquarium, which has the advantage of cheapness, is greatly in request, formed of a propagating glass turned upside down, and set on a stand of polished mahogany or rosewood. This form has cylindrical sides, and a rounded bottom, terminating in a knob, which, being inserted into a cavity in the stand, gives security to the whole. The bottom should be covered with sand or earth to a height sufficient to bring it up to the level of the cylindrical sides, for the convenience of observation. Vessels of this shape are now made up to twenty inches in diameter.

Messrs. Lloyd and Summerfield, of Birmingham, have recently published some very elegant designs for Aquaria. They construct rectangular tanks wholly of glass, the bottom, the corner-pillars, and the bars which connect them above, being all of that material. Their scale of prices, however, seems very high. Specimens of their productions may be seen at the Crystal Palace, and at 35 and 36, Aldermanbury, London.

Confectioners' show-glasses are very suitable for small specimens; they are usually about twice as high as broad, and are therefore the more graceful. These afford peculiar facilities for the examination of their contents with a lens, as they can be easily moved round, and may be placed before a candle or lamp for nocturnal investigations. They may be had of various sizes, from three to eight inches in diameter; six inches is a very convenient size. I have made very pretty vases for minute objects by taking the

glass chimney of an Argand lamp, and fastening a well-fitted cork into one end for a bottom, on which I then poured black sealing-wax varnish until a smooth water-tight surface was formed. These are more convenient than wide-mouthed phials, as the sides are more truly perpendicular, and we avoid the unequal refraction produced by the thickened bottom of a phial.

For a conservatory, to which an Aquarium would form an appropriate accessory, a vase-like form might be given to a large tank. If the outline were octagonal, the objects in the interior would be visible through the plate-glass without the distortion caused by unequal refraction, which is a great objection to vessels with curvilinear sides. But in such a situation, the chief point of view would be from above the surface of the water; hence the depth should be comparatively small, and the sides might recede, so as to increase the width upwards.

A good many animals, especially Anemones, Madrepores, Crabs and Annelides, may be kept in broad and shallow pans, in which the water does not exceed three or four inches in depth. The glass pans used for milk are good for this purpose. I have an earthenware pan with upright sides, about five inches deep, in which I have imitated the broken interior of a rock-pool, with irregular projections and promontories of cement. One advantage of such a vessel is that sea-weeds may almost be dispensed with, the extensive surface of water absorbing a large quantity of oxygen from the air. An oval foot-bath of whiteware makes a capital Aquarium.

COVERING.—Within an inhabited room, or wherever there is much liability to dust or soot, as there is necessarily everywhere in cities and large towns, the Aquarium may be protected by a cover. This may be made of fine muslin, or, which is better, of plate- or sheet-glass, according to the dimensions required. The latter may simply be laid over the top of the vessel, allowing the escape of gases under the edge. It should be occasionally lifted for a moment, to allow of a change of the superincumbent air:—the necessity of this will be manifest, from the close smell which is perceived on lifting the cover, especially if there be many sea-weeds in the tank.

In ordinary circumstances, however, there is no necessity for a covering of any kind. My own tanks, though placed in an inhabited room, remain for months together uncovered, in winter and summer, without the least loss of transparency. The dust speedily sinks, and is harmless.

ASPECT.—The free access of light to the plants is indispensable; and therefore that situation is the best where the sun's rays fall most freely on their leaves. It is beautiful to see the thousands of tiny globules forming on every plant, and even all over the stones, where the infant vegetation is beginning to grow; to see these globules presently rising in rapid succession to the surface all over the vessel, and to see this process going on uninterruptedly as long as the rays of the sun are uninterrupted.

Now these globules consist of *pure oxygen*, eliminated by the vegetation under the stimulus of light; and as this is the vivifying principle of animal life,

the importance of the process will be readily acknowledged. The difference between the profusion of oxygen-bubbles produced on a sunny day, and the paucity of those seen in a dark, cloudy day, or in a northern aspect, is very marked.

Yet there is one caution required. In summer the heat of the solar rays is very great, as well as their light; and if the vessel be small, and the volume of water very limited, it will become tepid in the mid-day sun, and the animals will be killed. Hence, in a fierce summer day, it will be desirable to draw down the window-blind, or to interpose a curtain of muslin, oiled-paper, or ground glass, which will break the full power of the rays, without greatly interfering with their illumination.

On this subject, a suggestion made by Mr. George Guyon in the "Zoologist" for March, 1856, is worthy of attention. "Since photography has become a popular science, it is pretty generally known that the three principles existing in common light—luminosity, heat, and chemical action—are to a great extent separable, and reside respectively in the yellow, red, and blue rays of the spectrum. It is, moreover, I believe, considered that growing plants decompose carbonic acid, and liberate the oxygen under the influence of the luminous or yellow rays: if this latter opinion is correct, would not the interposition of a screen of *yellow* glass, while giving free admittance to the purifying influence, effectually prevent the water from getting over-heated, by arresting the progress of the red or heat-giving rays?"

THE PREPARATION.

Your Aquarium being brought home, fixed in its intended situation, and properly seasoned, the next thing is to fit it up as a dwelling for its living inhabitants. Two or three points may be noticed here.

ARTIFICIAL ROCKS, CORALS, &c.—When the two longer sides only of the Tank are of glass, the two ends being made of slate, the latter should be veiled, by being made to imitate the irregular projections and ledges of rock, which may be done in a very picturesque maner. For this purpose, Roman, Portland, or other cement which hardens under water, should be employed; the slate must be faced with this, which while plastic may be fashioned into the semblance of rock. Pieces of branching corals may be set in it, if the effect of such accessories be thought desirable, and cavities may be formed here and there, into which the fragments of stone that support growing sea-weeds may afterwards be dropped, so that the tufts may droop elegantly from the mimic cliff. A more elegant way of appropriating branching corals, is to make a broad foot of cement to them, plunging the base of the branch in it while soft; these, when the cement has hardened, will stand on the floor of the tank like trees, and imitate more perfectly the mode of growth of the arborescent madreporos.

Whenever cement is used, it will be absolutely necessary to allow it to remain in water for at least a month, in order to soak out the free lime, before it be

introduced into the water which contains animals. The water in which it is soaked should be frequently changed; and as long as any prismatic scum appears on the surface, the cement is unfit for use. I have known a whole consignment of animals killed in one night from a neglect of this precaution.

THE BOTTOM.—As very many marine animals burrow, and as the observation of their proceedings is very interesting, they should be provided with the means of gratifying their inclinations. For this purpose a layer of sand should be put on the bottom of the tank, which may vary in depth from one to three inches. If sand from a sea-beach can be readily obtained, it is the most suitable: but the next best is coarse river-sand, such as the Thames sand commonly sold at the stone-wharves of London for building purposes. It should be well washed, until the water runs away clean: fresh water will do very well for this, but it must be drained off before the sand is put in. What is called silver-sand, and the common yellow earthy sand, sold in the shops for scouring, are not at all suitable, as they will tinge the water after any amount of washing, the former with lime, the latter with ochre.

Small pebbles or fine gravel, likewise well washed, may be used to vary the bottom with the sand.

Masses of rock, of dimensions suitable to the Aquarium, should be put in, to afford shelter and concealment to such animals as like the gloom. To afford this in the highest degree, a flat piece may be set, like a table, or *cromlech*, upon two or three upright blocks; or two tall pieces may lean against each

other, forming a rude arch ;—care being taken, whatever arrangement be chosen, that the masses stand with stability. It is of little consequence what sort of rock is selected,—limestone, sandstone, granite, conglomerate,—but the rougher, and the more full of cavities and angles, the blocks are, the better will be the effect.

WATER.—The purity of the water is of great importance. In London, sea-water may be easily obtained by giving a trifling fee to the master or steward of any of the steamers that ply beyond the mouth of the Thames, charging him to dip it in the clear open sea, beyond the reach of rivers. I have been in the habit of having a twenty gallon cask filled for me, for which I give a couple of shillings.

The vessel in which it is conveyed requires attention. A cask is the best, if a considerable quantity of water is required ; but it is absolutely indispensable either that it should be new, or at least that nothing injurious should have been previously contained in it, such as spirits, wines, chemicals, acids, &c. ; since no soaking will prevent hurtful qualities from being communicated to the water. Even the bungs ought to be new ; I knew an instance in which a consignment of animals was lost, from no traceable cause, except that the water-cask, which was quite new, had been stopped with a bung which had been previously used in a jar of some chemical solution ; yet the bung had been, as was supposed, *thoroughly* soaked and cleansed. If a cask of fir-wood can be procured, it is preferable : the wood of oak, of which wine-casks are usually made, gives out *tannin* or *gallic acid*, to the contained

water, which by its astringency converts the animal integuments into leather; if the water on coming out of the cask has a brown tinge, without interfering with its transparency, this is suspicious. If you cannot get any other than an oak cask, let it be well seasoned for two or three weeks before it is used, by filling it with water (fresh or salt), changed every day.

For smaller quantities of water, large jars of stone-ware are the best, being free from every objection arising from liability to taint or tinge. Both casks and jars can be easily sent by railway to any part of the kingdom; and pure water will not spoil by delay.

ARTIFICIAL SEA-WATER.

In July, 1854, I published the following communication in the "Annals and Magazine of Natural History."

"On manufactured Sea-water for the Aquarium."

"The inconvenience, delay, and expense attendant upon the procuring of sea-water, from the coast or from the ocean, I had long ago felt to be a great difficulty in the way of a general adoption of the Marine Aquarium. Even in London it is an awkward and precarious matter; how much more in inland towns and country places, where it must always prove not only an hindrance, but to the many an insuperable objection. The thought had occurred to me, that, as the constituents of sea-water are known, it might be practicable to manufacture it; since all that seemed

necessary was to bring together the salts in proper proportion, and add pure water till the solution was of the proper specific gravity. . . .

" I took Schweitzer's analysis ; but as I found that there was some slight difference between his and Laurent's, I concluded that a very minute accuracy was not indispensable. Schweitzer gives the following analysis of 1,000 grains of sea-water taken off Brighton :—

Water	964·744
Chloride of sodium	27·059
Chloride of magnesium	3·666
Chloride of potassium	0·765
Bromide of magnesium	0·029
Sulphate of magnesia	2·295
Sulphate of lime	1·407
Carbonate of lime	0·033
<hr/>	
	999·998

" The bromide of magnesium and the carbonate of lime I thought I might neglect, from the minuteness of their quantities ; as also because the former was not found at all by M. Laurent in the water of the Mediterranean ; and the latter might be found in sufficient abundance in the fragments of shell, coral, and calcareous algæ, thrown in to make the bottom of the Aquarium. The sulphate of lime (plaster of Paris) also I ventured to eliminate, on account of its extreme insolubility, and because M. Laurent finds it in excessively minute quantity. The component salts were then reduced to four, which I used in the following quantities :—

Common table salt	3½ ounces.
Epsom salts	¼ "
Chloride of magnesium	200 grains
Chloride of potassium	40 , " } Troy.*

To these salts, thrown into a jar, a little less than four quarts of water (New River) were added, so that the solution was of that density that a specific gravity bubble 1026 would just sink in it.

"The cost of these substances was—sulph. mag. 1*d.*; chloride mag. 3*d.*; chlor. pot. 1½*d.*; salt, nil; —total, 5½*d.* per gallon. Of course, if a larger quantity were made, the cost of the materials would be diminished, so that we may set down 5*d.* per gallon as the maximum cost of sea-water thus made.† The trouble is nothing, and no professional skill is requisite.

"My manufacture was made on the 21st of April, 1854. The following day I poured off about half of the quantity made (filtering it through a sponge in a glass funnel) into a confectioner's show-glass. I put in a bottom of small shore-pebbles, well washed in fresh water, and one or two fragments of stone with fronds of green sea-weed (*Ulva latissima*) growing thereon. I would not at once venture upon the admission of animals, as I wished the water to be first somewhat impregnated with the scattered spores of the *Ulva*; and I thought that if any subtle elements were thrown off from the growing vegetables, the water should

* The table salt and the Epsom salts I weighed by Avoirdupois; it would have been more strictly accurate if I had reduced the whole to Troy. Exact precision is not, however, at all essential.

† This was considerably over-rated: the cost is probably about 3½*d.* per gallon.

have the advantage of it, before the entrance of animal life. This, too, is the order of nature ; plants first, then animals.

" A coating of the green spores was soon deposited on the sides of the glass, and bubbles of oxygen were copiously thrown off every day under the excitement of the sun's light. After a week, therefore, I ventured to put in animals as follows :—

2	<i>Actinia mesembryanthemum.</i>	<i>Coryne ramosa.</i>
7	<i>Serpula triquetra.</i>	<i>Crisia eburnea.</i>
3	<i>Balanus balanoides.</i>	,, <i>aculeata.</i>
2	<i>Sabella</i> — ?	<i>Cellepora pumicosa.</i>
2	<i>Sabellaria (alveolata ?)</i>	<i>Cellularia ciliata.</i>
2	<i>Spio vulgaris.</i>	<i>Bowerbankia imbricata.</i>
1	<i>Cynthia (quadrangularis ?)</i>	<i>Pedicellina Belgica.</i>

" These thrived and flourished from day to day, manifesting the highest health and vigour ; the plants (including one or two Red Weeds that were introduced with the animals) looked well, and the water continued brilliantly crystalline. Within the succeeding month, specimens of *Actinia mesembryanthemum*, *A. anguicoma*, and *A. clavata*, a *Trochus umbilicatus*, and a *Littorina littorea* were at different times added.

" Six weeks have now elapsed since the introduction of the animals. I have just carefully searched over the jar, as well as I could do it without disturbing the contents. I find every one of the species and specimens mentioned above, all in high health ; with the exception of some of the Polyzoa, viz. *Crisia aculeata*, *Cellepora pumicosa*, *Cellularia ciliata*, and

Pedicellina Belgica. These I cannot find, and I therefore conclude that they have died out; though, if I chose to disturb the stones and weeds, I might possibly detect them. These trifling defalcations do in nowise interfere with the conclusion, that the experiment of manufacturing sea-water for the Aquarium has been perfectly successful.

“ P. H. GOSSE.

“ 58, Huntingdon Street, Barnsbury Park,
June 9, 1854.”

The small quantity of water thus experimented upon remains up to this time (June, 1856), having supported animal and vegetable life ever since without interruption, a period of two years and two months. It is as transparent as the day it was put in, rivalling the water of the clearest rock-pool, from which it can in no respect be distinguished, either in its sensible qualities, or in its fitness for plants and animals. Since that time I have made other and larger quantities, with the same success; so that I can confidently recommend the formula for general adoption. The salts are sold in packets, with all needful directions, by Mr. Bolton, a chymist in Holborn.

It is interesting to find that the more subtle constituents of sea-water, as *Lime*, *Iron*, *Silica*, and *Iodine*, which I neglect in my formula, are gradually communicated to the artificial composition by use. Dr. George Wilson, of Edinburgh, who has analysed portions of each of my preparations, after several months' use, finds traces therein of all these substances, according to a Report on the subject, read at

the Glasgow Meeting of the British Association in 1855.

It is scarcely necessary to add, that, if you can conveniently procure water from the sea, you should do so by preference ; “*si non, his utere mecum.*”

I am glad to fortify my own statements of the perfect success of this Artificial Sea-water, by the experience of Mr. W. A. Lloyd, who, by his extensive and rapidly-increasing business of supplying stocked Aquaria to every part of England, is well qualified to express a judgment. *Mr. Lloyd for a long time never used any other water than this composition.** The results of his observations were communicated to the Microscopical Journal for July, 1855, in the following paper, which, as it bears not only on the question of water, but on the general subject of this volume, I shall, with the permission of the author, quote entire.

“ *Memoranda on the employment of Artificial Sea-water in Marine Aquaria.* ”

“ Early in the summer of last year I commenced some experiments on artificial sea-water, made according to the formula proposed by Mr. P. H. Gosse ; the ingredients, in the proper proportions, having been procured from Mr. William Bolton, 146, Holborn Bars, London. In it I have successfully maintained alive the following marine productions :—

ANIMALS. 2 *Hydractinia echinata.*

Zoophytes. 3 *Actinia mesembryanthe-*

1 *Clava multicornis.* *mum.*

* He now supplies real sea-water, as well as artificial, according to the wishes of his customers.

4	<i>Actinia crassicornis.</i>	27	<i>Pecten opercularis.</i>
5	„ <i>bellis.</i>	28	<i>Doris pilosa.</i>
6	„ <i>parasitica.</i>	29	„ <i>tuberculata.</i>
7	„ <i>dianthus.</i>	30	<i>Eolis coronata.</i>
8	„ <i>anguicoma.</i>	31	<i>Ancula cristata.</i>
9	„ <i>clavata.</i>	32	<i>Lamellaria per-</i> <i>spicua.</i>
10	„ <i>aurora.</i>	33	<i>Nerita</i> — ?
11	<i>Anthea cereus.</i>	34	<i>Littorina littorea.</i>
12	<i>Caryophyllia Smithii.</i>	35	<i>Rissoa</i> — ?
13	<i>Sertularia polyzonias.</i>	36	<i>Trochus zizyphinus.</i>
14	„ <i>filicula.</i>	37	<i>Purpura lapillus.</i>
15	„ <i>pumila.</i>	38	<i>Chiton fascicularis,</i> and <i>C. laevis.</i>
16	<i>Flustra membranacea.</i>		<i>Cirrhipedes.</i>
17	<i>Bowerbankia imbricata.</i>	39	<i>Balanus balanoides.</i>
18	<i>Vesicularia spinosa.</i>	40	— — ?
	Annelides.		VEGETATION.
19	<i>Serpula contortuplicata.</i>	41	<i>Ulva latissima.</i>
20	„ <i>triquetra.</i>	42	<i>Enteromorpha com-</i> <i>pressa.</i>
21	<i>Sabella</i> — ?	43	<i>Cladophora</i> — ?
22	<i>Terebella conchilega.</i>	44	<i>Phyllophora rubens.</i>
23	<i>Spio vulgaris.</i>	45	<i>Bryopsis plumosa.</i>
24	<i>Nereis</i> — ?		
25	<i>Pontobdella muricata.</i>		
	Mollusca.		
26	<i>Cynthia morus.</i>		

"The only accommodation provided for the whole of the above is a series of glass jars and vases placed on shelves in the windows of an ordinary London dwelling-room; the largest glass not exceeding three gallons' capacity. It is not pretended, however, that those animals, which are notoriously short-lived in

confinement (such, for instance, as Nos. 27 to 32), even under the most advantageous circumstances of space, had their existence more prolonged with me; I would merely state, that I have met with no more difficulties with the artificial than with the actual sea-water, under the same conditions. Nos. 1 (this is now in the gravid state represented in 'Johnston's Zoophytes,' plate 1), 2, and 16, made their appearance spontaneously, as it were, on some empty shells and other débris placed in the water six months before, which had not been changed during the whole of that period. Nos. 3 and 5 to 10 are very hardy with me; but No. 4 is, in general, precarious. Nos. 13, 14, 15, lived in a quart jar for three months; at the end of which time I disposed of them, after they had added hundreds of new cells to the polypidoms. Nos. 19, 20, 21, added considerably to their tubes; the new portion being indicated in No. 20 by its superior whiteness, and the rate of increase being about a third of an inch in six months. On the 1st of May, I counted ten young of this species, the parents having been in my possession since September 4. Colonies of No. 23 are very vigorous and active; but I find that they have a period of rest from soon after midnight to about 4 or 5 P.M.

"Many of the *Actiniæ*, mentioned in the above list, are the same individuals which I had at the commencement of my experiments, and most of them have brought forth young abundantly. The development of Nos. 16 (this especially), 17, 18, have afforded me many weeks of most interesting observation. In Nos. 39 and 40 I have noticed that

frequently the *cirrhi* have begun to play as quickly as ever, even after a period of inaction so long that I have supposed the animals to be dead.

"In the vegetation, I find that No. 42 is the most effective in the evolution of oxygen. No. 41 stands next. No. 44 is apt to decay, if not placed in a shaded spot; but it is always interesting, from the quantity of parasitic animals usually found in it.

"I trust that these desultory observations, hastily thrown together, but scrupulously containing nothing that I have not personally witnessed in my own collection, will have the effect of increasing the domestication of the interesting productions of our shores.

"WILLIAM ALFORD LLOYD.

"164, St. John Street Road, Islington,
"June 6, 1855."

THE STOCK.

As I shall presently give some instructions concerning the modes of collecting both plants and animals, a few preliminary observations are all that will be needful here.

PLANTS.—What are the most suitable plants for an Aquarium? Not the Oar-weeds or Tangles (*Laminaria*); for though young specimens have an attractive appearance, they will not live long in captivity; they presently begin to decay, and slough off in slimy membranous shreds, filthy to look at, and hurtful to the living creatures. The *Fuci* live pretty well, but their sliminess and ugliness are fatal to their pretensions; and they are, moreover, apt to tinge the

water of a brown hue. From the Red and the Green orders we must make our selection.

Of the former these will be found good : *Rhytiphlæa pinastroides*, the *Polysiphoniæ*, *Corallina officinalis*, *Delesseria alata*, *Gracilaria confervoides*, *Gelidium corneum*, *Polyides rotundus*, *Chondrus crispus*, *Phyllophora rubens* (this, especially when dredged from deep water, is one of the very best), the *Griffithsiæ*, and some of the *Callithamnia*.

Of the Green weeds, *Codium tomentosum* does pretty well, and affords food for some Mollusca that will eat nothing else. The *Cladophoræ* are good ; *Bryopsis plumosa*, a most elegant little plant, flourishes in confinement ; but the *Enteromorphæ* and *Ulvæ* are probably the best of all sea-weeds for our purpose, and the most easily procured on every shore.

The pieces of rock to which the plants are attached should be as clean as possible. All adhering Sponges, in particular, should be carefully scraped off, unless they are wanted for immediate examination ; as they are almost sure to die, and corrupt the soil and water with sulphuretted hydrogen,—a most nauseous and noxious gas, which turns everything black with which it comes into contact.

ANIMALS.—Of the animals which thrive best in an Aquarium (speaking, of course, only from my own limited experience and observation), the following may be mentioned :—

Fishes.—The smaller Sticklebacks ; young specimens of the Grey Mullet, which have lived for more than three years in the Zoological Society's Aquarium ; the Blennies and Gobies ; the Spotted Gunnel ; the

smaller Wrasses; the Rocklings; the Flounder; the Dab; the Eels.

Mollusca.—The Sea-hare; the Periwinkle; the commoner Tops; the Purple; the Murex; the Chitons; the Bullas; the Scallops; the Mussel; the Modioles; the Anomia; the Oyster; and some of the sand-burrowing bivalves, as *Venus*, *Mactra*, *Pullastra*, &c. *Gastrochæna* and *Saxicava*, burrowers in stone, may be readily kept, and are very interesting, especially the former, which I have had in confinement for many months, in more than a single instance, and still possess.

Cirripedes.—The Acorn-barnacles (*Balanus* and *Chthamalus*), and the interesting little *Pyrgoma*, which is invariably found cemented to the plates of our larger Madrepore.

Crustacea.—The Strawberry Crab; some of the Swimming Crabs; the Shore Crab; the Eatable Crab; the Hairy Crab; the *Ebalia*; the Masked Crab; the Soldier Crabs; the Broad-clawed Crab; the Shrimps; the true Prawns; the *Athanas*; many of the *Entomostraca*.

Annelides.—The Gold-comb; the Sabellas; the Serpulas; the Sea Leech; the Long Worm; the Terebellas.

Zoophytes.—Most species of Sea-Anemone (except the Thick-horn, *Bunodes crassicornis*, which is precarious); both species of Madrepore.

The following are interesting, and may be preserved for a considerable time, but are rather more uncertain. Among FISHES, the Sea-scorpion (*Cottus*); the Fifteen-spined Stickleback; the Butterfly Blenny; the

Suckers; the Pipe-fishes. Among MOLLUSCA, all the Nudibranch, and most of the Tectibranch species; the *Naticæ*, the Cowry, the Whelk; the little *Rissoæ*; the *Phasianella*; the Cup-and-Saucer (*Calyptrea*); the lovely little *Acmea*; many Bivalves; the *Cynthiae*, and *Ascidiae*. Among CRUSTACEA, the *Pisæ*; the *Portuni*; small specimens of the Common Lobster; the *Hippolytes*; *Pandalus*; *Gammarus*; *Idotea*. Among ANELIDES, the Sea Mouse; the Nereides; and the *Planariae*. Of ECHINODERMS, the *Cribella*, *Palmpipes*, *Asterina*, *Asterias*, *Echinus*, and *Cucumaria*.

PROCURING SPECIMENS.—By far the most interesting mode of acquiring your stock, is the collection of it by your own personal research. But as this is not in every case practicable, we must have recourse to the labours of others. In London, Mr. W. A. Lloyd, 19 and 20, Portland Road, New Road, is a “Dealer in Living Marine Animals, Sea-weeds, Natural and Artificial Sea-water, and Marine and Fresh-water Aquaria :” he will undertake the whole labour of supplying and stocking these interesting repositories of ocean life.*

TRANSMISSION OF SPECIMENS.—Both plants and animals should be forwarded to their destination as soon after they are collected as possible; but, if they are detained, they may be kept in pans of sea-water, exposed to the light. The vessels, however, must be protected from heavy rains, as the admixture of a

* Mr. Lloyd is constantly supplied with marine animals from the Kent, Dorset, South Devon, North Devon, and Welsh coasts, and occasionally from Cumberland, and the Channel Islands; so that his stock in London possesses a variety not to be found in any single locality on our shores.

large quantity of fresh water would be fatal to both plants and animals. Should much rain have fallen on a vessel containing specimens, it should be carefully tilted, so as to allow the fresh water, which, from its less specific gravity, will be lying on the surface, to run off without mingling with the other. If this be well done, most of the collection, at least that portion of it which was nearest the bottom, may be preserved.

Living sea-weeds may be transmitted to long distances without water. I used to employ a tin box, enclosed by a basket. At the bottom I placed a layer of refuse weed, the common *Fucus serratus*, freshly gathered, and quite wet. On this bed I laid the growing specimens (arranging the pieces of rock so as not to shake about and injure the plants) until the box was nearly full; over all, refuse weed was again laid, filling up all hollows, and so pressing the whole when the box was shut, as to prevent any motion of the stones. The specimens arrived in the best condition, even the delicate *Delesseriae* being uninjured.

Many animals may be forwarded in the same way. The Mollusca, many of the Echinodermata, several of the Crustacea, and all the Actiniaæ are transmitted with more ease and less danger thus than in water. A handful of loose weed, wet with sea-water, to keep a moist atmosphere around them, may be thrown into a canister or jar, and the animals placed in among it. The vessel should not be *filled*, nor should any pressure be allowed on the animals; the weed too, though fresh, must be plucked, as pieces of rock would be injurious to the more tender animals.

Fishes, however, many Crustacea, most of the Annelida, all Medusæ, and the more delicate Zoophytes, require to be sent in sea-water. I sometimes use wide-mouthed jars of stone-ware, with water-tight screwed tops,* several of which may be packed in a hamper; at other times a large 12-gallon zinc pail, protected by a wicker case, with a screw lid, of which the central part is perforated with minute holes; at others, four small zinc cans, of square form, with perforate tops, fitted into an open box, like case-bottles in a wine-hamper. All of these modes answer well; I know not to which I should give the preference; except that for Fishes the large pail is decidedly the best. If heavy stones or oyster-shells, very rich in Zoophytes and Annelides, be required, a common cabbage-net may be suspended from the lid of the pail in mid-water; the stones or shells, being put into this net, will be kept from injuring themselves or their neighbours by banging about upon the bottom.

The more brief the period during which the specimens are *in transitu* the better. Hence they should be always forwarded *per mail train*, and either be received at the terminus by the owner, or else be directed "To be forwarded immediately by special messenger." The additional expense of this precaution is very small, and it may preserve half the collection from death through long confinement.

The packages should be opened immediately on arrival; several bowls, pans, &c., being ready, each half-filled with sea-water. The water in the vessels just received should be carefully dipped or poured off,

* These may be procured at 137, High Holborn.

and the specimens placed one by one in the bowls. Thus you will not only see which are alive and healthy, and which are sickly or dead; but the weeds, shells, &c. will be rinsed from the sediment, which has been abraded during the rattling of the specimens in travelling. The specimens can afterwards be deposited in the Aquarium, their permanent home.

Should any of the more delicate animals appear much exhausted, they may often be restored by a prompt aeration of the water around them. This is most readily effected by means of the Syringe, as I shall presently describe.

If you can so arrange matters, it will be a useful caution to allow your plants exclusive possession of the Tank for a week or two, not putting any animals in, until you see bubbles begin to form all over the sides, bottom, and rock-work, when the sun-light shines on them. This appearance will indicate a growth of incipient vegetation, which will greatly lessen the chance of death when the animals are introduced.

Finally, be moderate in your desire of dominion. Do not overcrowd your Tank. It is far better to have it but half occupied at first, and to add to its population from time to time, than, by a too eager desire to see it filled, make it a Black Hole of Calcutta, and mourn over a host of corpses, the wreck, perhaps, of a single night. Half-a-dozen animals, averaging the bulk of a Periwinkle, or a moderate-sized Sea-Anemone, to every gallon of water, are quite enough to begin with.

GROWTH OF ALGÆ.—Since the first edition of this

work was published, cultivators of the Marine Aquarium have succeeded in propagating both plants and animals of many species. The lowest forms of the green Algæ,—the *Confervadæ*,—presented no difficulty from the first, but the growth of large fronds of *Ulva*, and of dense tufts of *Bryopsis plumosa*, did not occur till after some experience. Both of these now grow profusely in my older Tanks; the young fronds of the former, which is an annual plant, appearing early in the winter, and increasing during the summer, so as almost to fill the vessel, and requiring to be freely thinned out by hand. The *Bryopsis* is wayward. In some tanks it will grow luxuriantly, and (as it seems) spontaneously, while in others it refuses to shoot. It appears with me especially to favour the artificial water.

In June 1854 I published, in the "Annals of Natural History," my observations on the first growth of the Red Algæ in confinement. This growth was confined to the increase of old specimens by the pushing forth of fresh shoots; but since then I have had several specimens of *Chondrus crispus* springing from the surface of the glass sides of the Tank, and also of *Corallina officinalis* in the same situation. Both these were, of course, the produce of spores self-sown. I have also, at the present time (June 1856), plants of *Chondrus crispus*, *Phyllophora rubens*, *Plocamium coccineum*, a fine *Ceramium*, and several other *Rhodospermeæ*, in a growing state.

But all my specimens are insignificant compared with those that have appeared in one of the Zoological Society's Tanks in the Regent's Park. The

water in the Tank to which I refer—one near the centre of the house—has been untouched since June 1855. There are now to be seen in it, a beautiful plant of *Chylocladia kaliformis*, consisting of several fronds two inches and a half high, of the most lovely pellucid crimson; a small tuft of *Ptilota plumosa*, and several fine bushes of a slender straight-tipped crimson *Ceramium* (probably *C. botryocarpum*), one of which is fully five inches broad, and three inches high. All these have sprung up spontaneously, and are truly the ornament of the Tank, and the triumph of the principle on which the Aquarium is formed.

INCREASE OF ANIMALS.—Among animals, the *Actiniæ* readily produce their young in captivity: the FORAMINIFERA increase with me abundantly: *Hydra tuba* propagates by gemmation, and in the Zoological Gardens has, I believe, produced the Medusa. The *Campanulariadae* extend their threads, and form numerous cells: a species of *Lombrinereis*, a little Worm apparently undescribed, is produced in my Tanks by thousands: *Sabellæ*, *Serpulæ* and *Spirorbæ* appear unexpectedly: the microscopic ROTIFERA, as *Furcularia*, *Monura*, and particularly the pretty *Brachionus Müllerii*, breed freely, as do also several species of ENTOMOSTRACA. The POLYZOA spring up spontaneously: in the Gardens some magnificent specimens of *Ascidia*, as well as *Botryllus*, have appeared: the Periwinkle and the Mussel breed with me; and I have reared three successive generations of a large mollusk,—*Bulla hydatis*, and have now the spawn which is destined to produce the fourth.

No doubt these lists will soon be greatly increased.

I scarcely know a more interesting occupation,—certainly there is no more delightful part of aquarian study,—than the detection of some unexpected, unrecognised form of animal or vegetable life in our Tanks, and the watching of the little stranger as it assumes, from day to day, new bulk, beauty, and character.

GENERAL DIRECTIONS.

The Aquarium is, then, established. The water, which at first is somewhat turbid, becomes in the course of a day or two clear and crystalline; the plants expand their feathery tufts in beauty, and the animals begin to take possession of their holes and corners, and to find themselves at home. But you must lay your account with the loss of some specimens; some will certainly die in the course of the first twenty-four hours, others in the first week. But those which survive the first ten days may be considered as pretty well established.

It is during this period that the grand trial of the experiment usually occurs. There is generally a large amount of animal matter attached to the seaweeds, shells, and stones, which are received from the sea, such as minute Annelida, Mollusca, and Zoophytes: very many of these creatures are already dead, or die immediately; but being too minute to be detected and removed in detail, they decay, and presently contaminate the water. The first symptom of this is a slight dimming of the crystal translucency, which, if unchecked, soon increases to a milky whiteness, accompanied by a fetid odour, and terminates in the death of the whole animal collection.

PURIFICATION.—As soon as this begins to be perceived, the whole water should be drawn off by means of a siphon, without disturbing the sediment, into pans, into which, for the present, the plants and animals may be put. The Tank should be wiped out and rinsed, and then the water should be filtered back into it. This is a very simple process : a funnel (if of glass, earthenware, or gutta-percha, the better) is placed over the Tank, with a bit of sponge pushed lightly into the top of the tube, so as to allow the water to run through in a narrow, thread-like stream.

Replace the plants and animals, reserving those pieces of rock, or those shells, that look suspicious, which may be kept in a bowl of water by themselves for a few days, till their state appears more fully.

This process of bringing every drop of the water into contact with the atmosphere, is an effectual remedy for destroying the tendency to putrefaction ; as the animal fluids and solids held in suspension enter into combination with the oxygen of the air, and form the pure innocuous gas called *ozone*. The result will be that the milkiness will rapidly disappear ; the water will assume a transparent clearness, which will in all probability be permanent ; the plants will thrive, and the animals will be lively. This result will be rendered still more secure by filtering the water through pounded charcoal, and by allowing some pieces of the same substance to float in the tank.

Should it happen that from oversight or ignorance, or any other cause, putrefaction has thoroughly set in, still you need not lose the water. Take out any animals that are yet alive, as well as the weeds, and

then put the water, in *an open vessel*, in some shed or out-house, where the fetor will be of no consequence. Leave it there for the putrefactive process to run its course, which it will do in two or three weeks, if the weather be warm. The water will then gradually resume its original clearness and purity; the weeds may now be replaced in it; it should be well agitated frequently, and soon you may put in, cautiously at first, your animals, and everything will be right again.

OCCASIONAL DEATH.—It will still be needful to exercise a watchful supervision of the collection. It must be remembered that both the animals and plants are not in their natural circumstances, and that a certain amount of violence is done to their habits. Death, which spares them not at the bottom of the sea, will visit them in the Aquarium; and hence the vessel should be occasionally looked over, *searched*, as it were, to see if there be any of the specimens dead. If the plants show an orange hue in patches, they must be taken up, and the diseased parts cut clean away. Dead animals must be at once removed, or contamination will soon result. The eye will soon recognise the individuals, and will miss the familiar forms; but you must not too hastily conclude that an animal, which you have been accustomed to see playing about, is dead, because you have not observed it for some days, and cannot find it. Probably it has secreted itself in some corner or crevice, whence it will emerge in a day or two. Still, such a circumstance should excite your vigilance.

INSTRUMENTS.—For removing dead specimens or

the like, a pewter spoon bent up to a right angle, with the shaft tied to a slender stick, is very useful. You can, if you please, make a more elegant affair of it. Two or three simple sticks or rods, some of them widened, spade-like, at the end, are also useful for pushing the specimens to any required point. And one or two small nets, made by stretching a bit of lace or muslin over a ring of wire, fastened to a rod, will serve to catch and lift out such animals as you wish to transfer, for examination, or any other purpose, to another vessel. As a general rule, however, they should be disturbed as little as possible, and never handled.

ARTIFICIAL AERATION.—Although living and healthy plants will educe and throw off, under the influence of light, oxygen, in sufficient quantity to maintain in health a given number of animals, yet the artificial admixture of atmospheric air with the water may be employed as a valuable auxiliary. I have used it with marked benefit; often having revived animals thereby, which, from the exhaustion of the water, were apparently in a dying state. Its utility as a means of maintaining the purity of the water is still more obvious; since it is by the frequent and successive presentation of the particles of water to the air, that the animal excretions which they hold in suspension become chemically changed, and deprived of their putrescent qualities. This is what takes place in nature. By the perpetual dashing of the waves against the shore, and especially against the ragged rocks, an immense quantity of air becomes entangled, in the form of minute bubbles, which by

the various currents are diffused through the sea, and even carried to considerable depths, before they rise to the surface and become dissipated. Thus the violent agitation of the sea is a powerful agent in its purification.

One of the simplest modes by which this object can be effected, is the drip-glass. I have been accustomed to suspend over the Aquarium, a perforated bell-glass (I think it is called a bee-glass) of suitable size, into the orifice of which a bit of sponge may be pushed, or a cork drilled with small holes. The cord which suspends the drip-glass passes over a pulley at the top of the window, so as to be raised or lowered at pleasure. Every morning sufficient water from the Tank is drawn or dipped off, to fill the drip-glass, which is then hoisted to its full height. The contents run out in slender streams, or in a rapid succession of drops, which, passing through some four or five feet of air before they reach the Tank, become effectually purified.

A convenient mode of aeration is that effected by strongly syringing the water. The instrument should be at least $1\frac{1}{2}$ inch in diameter, and should be raised above the surface at every down-stroke. After a few moments' work, the whole Tank will be quite white with minute bubbles of air, resembling the sea when the waves dash and boil among the rocks.

The same purpose may be more efficiently accomplished at a slight expense, in a manner which would greatly augment the elegance of the Aquarium. In the engraving placed at the commencement of this chapter, I have represented a Fountain-Aquarium, a

form of the invention particularly suitable for a conservatory or hall. It needs but a vessel, fixed as a reservoir, at some distance above the level of the Tank, in a higher story, for example, whence a supplying tube may descend, and passing beneath the floor, ascend through the foot of the vase, to the surface of the water. All the visible portion may be easily concealed among the rock-work; while from the extremity a jet would play, proportioned in force to the weight of the supplying column, or, in other words, to the height of the reservoir above the surface. It would be needful to make the apparatus of some incorrodible material;—gutta percha, for instance, for the tube, with a nozzle of glass;—as metals would be acted on by the sea-water, and form noxious oxides. The water might either be carried up to the reservoir, or pumped up by an obvious extension of the apparatus.

Such a modification would doubtless be as efficient as it would be elegant. The constant, or at least frequent, dissemination of the water through the air would keep the whole volume in agreeable coolness, as well as maintain its sparkling clearness and purity.

In a well-regulated Tank, however, none of these modes are necessary. My oldest reservoir, which has been in constant occupation for two years and six months, never has any artificial aeration, except an occasional syringing, and that is often intermitted for months together. The surface is now and then agitated with a stick, and broken by the addition of fresh water to supply the loss by evaporation, and this is all the external aid it receives. *Yet the water gene-*

rally maintains the most crystalline transparency and purity.

EVAPORATION.—If the Tank remain habitually uncovered, or protected only by a coverlid of muslin, daily evaporation will soon reduce the volume of the water, and increase its specific gravity. The pure water alone rises in vapour, the various salts held in solution remaining the same in quantity, though the water should be reduced to half its original bulk. It is therefore needful that additions of pure *fresh* water (not *sea*-water) be made from time to time, to replace the loss by evaporation. Distilled water is of course the best, but, practically, river-water will answer perfectly well. The time and quantity of these additions ought to be regulated by a hygrometer, the specific gravity of the sea-water being maintained at about 1027, which is the average density of the waters of the Atlantic. A tolerable approximation to accuracy, however, may be made, by marking on the vessel the surface-level at first, and always maintaining the same level. A glass cover greatly prevents loss from evaporation, as will be manifested by the condensed moisture on it, especially after a cold night.

CLEANSING THE SIDES.—Though a few Periwinkles, as already observed, will keep down the accumulation of green confervoid growth on the sides of the Aquarium, they will not do their work so regularly but that a rough coating of greenness will still dim the transparency of the glass. The unsightly appearance thus left must be got rid of by mechanical means. A stick with a bit of rag tied around its end, or, what is better still, a brush made on purpose, like

a nail-brush with a very long handle proceeding from the side—a sort of hearth-brush in miniature, fitted with very close and stiff bristles—will rub off the greenness. It may be used about once in a month, or oftener in summer. On the stones of the bottom, the cement and rock-work, and even on that side of the Tank which, being next to the window, is not used for observation, I would recommend that the green growth be not interfered with, but that the marine plants be allowed to grow undisturbed. A crop of self-sown weeds in the Tank is far more valuable than such as have been introduced on loose stones. And even from very early age the green growth is found to throw off a copious supply of oxygen bubbles. Care, too, must be taken not to molest or annoy the animals needlessly, as also to leave undisturbed any masses of spawn that may have been deposited on the glass.

TURBIDITY.—Occasionally the water in a tank, which has hitherto been quite translucent, becomes all on a sudden so turbid as completely to hide the contents from view, except such as are close to the glass. This turbidity may arise from either of two causes. If it is of a grey or whitish hue, forming clouds here and there, which disperse and form again elsewhere, the microscope will show that it is composed of an innumerable multitude of animalcules belonging to the Class INFUSORIA. Their presence is not an evil, but rather a means whereby an already existing evil may be remedied. Their sudden increase to such an extent as to be thus appreciable to the senses, is symptomatic of organic matters in the

Tank in a state of decomposition. If we allow a minute worm that has died to lie at the bottom of the Tank, we shall see in a day or two, if we watch it with a powerful lens, that it is encompassed by a little cloud of moving atoms, which are the animalcules in question, and which are busily engaged in devouring not only the solid parts, but also the juices and invisibly minute particles that float off; and thus in a very short time they effectually dispose of the offensive substance. So, in the case of their increase to the extent just supposed, of producing a general turbidity, they will, if left to themselves, soon clear away the decomposing matter, if it be not too great, and then themselves gradually disappear, allowing the water to resume its original clearness. As soon, however, as we perceive such an appearance, we should carefully transfer the principal animals to another vessel, and search for the decomposing bodies, on the removal of which the water will presently be transparent and sweet as before.

But the opacity of the water may be dependent on a totally different cause. If it is of a green colour, rapidly deepening in intensity, it is vegetable in its origin, and arises from an infinite number of the spores (or seeds) of green *Algæ* dispersed through the fluid, and held in suspension there. Now, this appears to have no deleterious influence either on the plants or animals, which live and thrive as well as when the water is clear; but it is annoying because of its unsightliness, and because it effectually interferes with our observation of our cherished favourites. It is, too, a most inveterate evil; unlike the former, it is not

self-curative, at least not certainly so, and it cannot be foreseen. I have had a large vessel that had been in full occupation for a year and a half,—during the whole of which time it had remained brilliantly colourless,—suddenly, without any imaginable cause, become green; and in the course of two days be so opaque that objects could not be discerned an inch from the sides.

The lens will not detect anything in the fluid in this case; it requires a very high power of the compound microscope to resolve the cause. With a magnifying power of 560 diameters, we see an immense number of oval atoms, apparently colourless (but, doubtless, having a very slight tinge of green visible only in the aggregate), and not more than $\frac{1}{5000}$ th of an inch in diameter. These I conceive to be the spores of a green *Oscillatoria*, or some kindred plant; for there is a tendency to the accumulation of the films of such plants in the vessels in which the phenomenon exists.

Sometimes this evil will continue unchanged for many months, and then clear away as suddenly as it came. At others, it will diminish and promise a return of transparency, then suddenly return, and set in as dark as before.

Mr. W. A. Lloyd has succeeded in overcoming this difficulty. By drawing off the green water, and putting it into a dark closet, he finds that in two or three weeks the turbidity quite disappears, the water resuming its pristine transparency. The explanation is doubtless as follows: light is necessary to the life of plants, or at least the green colouring principle in

them cannot be developed without light; if, then, this be denied, the plants must wane and die. Now the opacity, as I have intimated, consists of the living germs of green plants; and these, on being deprived of light, gradually die away; after which the water is quite fit for use again. I have myself instituted experiments on the subject, and, so far as I have proceeded, my results agree with those of Mr. Lloyd; except that I have found a seclusion of several months necessary. This was, however, in the winter.

Cloudiness may often be removed by the action of living animals. The Bivalve Mollusca collect the organic particles that float in the water, as the currents pass over their capacious gills, and either feed on them or consolidate them into cylindrical rolls, which fall to the bottom, enveloped in mucus. Hence they are of great service in making turbid water limpid and bright. An Oyster or two, according to the size of the vessel, will answer exceedingly well, as they are very hardy, and can be procured alive anywhere, and almost at all seasons.

Food.—I am continually asked, *how, with what, and how often* I feed my animals. My invariable reply is—"Not at all." I do not find that they need any supply but what they procure for themselves. In a well-stocked and established Tank, the vegetable-feeders find a sufficient pabulum in the ever-growing weed; and all the carnivorous species are maintained in condition by the hosts of INFUSORIA and ENTOMOSTRACA that are always swarming. The lens shows these tiny creatures to be abundant in every collection of water that has been kept for a short time; and as

they breed very fast, their increase is sufficient to meet the demands of their superiors in organization. At least, I find that my well-filled Tanks need no other supply than this, and what the more predatory kinds occasionally obtain by the death of their fellows. For amusement, indeed, the Actiniæ, the Madrepores, the Prawns, and the Crabs, may be fed; and then the best diet is the lean of raw meat, cut into minute fragments; but it should be very sparingly done, and the rejected atoms carefully removed, lest putrefaction set in and spoil the whole.

INSTRUCTIONS FOR COLLECTING.

TIME.—What is commonly called *low-water*—that is, the time when the ebbing-tide recedes to the utmost point—is the period to be chosen for shore-collecting, as comparatively few marine animals or plants habitually live in situations where they are long exposed to the air and sun. But the lower the level, the more rich becomes the harvest; and hence the time of spring-tide is the most productive, when the recess of the tide is the greatest. Spring-tides occur twice every month, viz. about the time of new and full moon; the very best tides of all are those of the second day after the change of the moon; but for two days before and two days after that, they recede very far; so that we may consider those weeks which commence two days before the change of the moon and end five days after it, as good collecting periods, while the alternate weeks are nearly useless. The

full-moon tides are generally greater than those of the new moon ; and those about the time of the equinoxes, or the spring-tides of March and April, and of September and October, are the best of the whole year. Prevailing winds, however, exercise some influence on the amount of recess of the tide.

The time of lowest water on any particular day can be readily ascertained from local tide-tables ; and the young collector, in choosing the locality of his operations, will pay attention to this point beforehand, that he may select a place where the time of low-water on the days of spring-tides is the most convenient for his occupation. For instance, the time of low-tide on the day of full-moon is about noon on our western shores, but about six o'clock on the Sussex coast.

IMPLEMENT.—I use a wicker-basket with a flat bottom and straight sides, divided into compartments. In two of these fit wide-mouthed jars, such, for example, as are used for preserves : if made of glass they are the better, as admitting a more ready examination of their contents ; but jars of white-ware or stone-ware will do. The larger objects procured are put into these ; and I commonly carry also a wide-mouthed phial, such as the chemists keep *quinine* in, fitted into a third compartment, to receive the minuter and more delicate things. Then there is a fourth division running the whole length of the basket, in which lie a hammer and chisel, and which may receive large shells, crabs, &c. that do not require constant immersion. A geologist's *hammer* with a cutting edge, as well as a striking face, is the most useful ; and the

chisel must not be such as carpenters use, but one made wholly of iron, tipped with steel, such as is used by smiths, and technically called a *cold chisel*.

Sometimes, especially if the shore we are about to search be strewn with large stones or boulders, it will be well to secure the attendance of a man with a crow-bar, to turn over the stones; as on their under surface, and beneath their shadow, valuable specimens are often found. With the same instrument, inserted into the fissures, great pieces of loose slaty rock may be wrenched off, which are very productive.

COLLECTING SEA-WEEDS.—Thus armed, we sally forth, choosing for our explorations a spot where low dark ledges of shelving rock run out into the sea, full of clefts and fissures half concealed by Bladder-weed and Tangle; or where the solid rock shoots up in irregular angular masses, scooped and hollowed into numberless little pools and basins, with dark, slimy caverns here and there, and rifts of shingly sand between. An unpractised foot would find the walking precarious and dangerous, for the rocks are rough and sharp, and the dense matting of black Bladder-weed with which they are covered, conceals many abrupt and deep clefts beneath its slimy drapery. These fissures, however, are valuable to us. We lift up the hanging mass of olive-weed (*Fucus*) from the edge, and find the sides of the clefts often fringed with the most delicate and lovely forms of sea-weed; such, for example, as the winged Delesseria (*D. alata*), which grows in thin, much-cut leaves of the richest crimson hue, and the feathery Ptilota (*P. plumosa*), of a duller red. Beneath the shadow of the coarser weeds, as

well as in open pools, delights also to grow the *Chondrus*, in the form of little leafy bushes, each leaf widening to a flattened tip. When viewed growing in its native element, this plant is particularly beautiful; for its numerous leaves glow with resplendent reflections of azure, resembling the colour of tempered steel. This weed when dried is used for making jellies, and constitutes the Carrageen Moss of the shops.

We may observe among the sea-weeds many tufts of a small species, whose leaves are much and deeply cut, with the divisions rounded, and the general outline of the leaf pointed. Some specimens are of a dull purple, others of a rich yellow hue; and I refer to the species as an interesting example of the influence of light on the colour of marine plants. The yellow specimens are exposed to the sun's rays; the purple ones are such as have grown in deep shadow. The species is the *Laurencia pinnatifida* of botanists.

Turning from the hidden clefts, we explore the deep pools that lie between the ledges. High wading-boots are necessary for this purpose, as we have to work in the water. The great Oar-weeds and Tangles (*Laminaria*) are growing here, large olive sea-weeds that wave to and fro with the undulations of the sea; the former a long narrow puckered frond of brown colour; the latter, a broad smooth leathery expanse of deeper colour on a slender stalk, splitting with age into a number of lengthened fingers or ribbons, and hence called the Finger Tangle (*Laminaria digitata*). Among these grow clusters of an elegantly frilled species, of delicate thin texture, and yellow-brown

hue, bearing no slight resemblance to the tresses of some fair lady: this also is a *Laminaria*, but I am not quite sure whether it is the young state of the former species, or entitled to a name of its own. In the latter case, it is the *L. phyllitis* of botanists.

In these deep pools grow also many bunches of broad dark-red leaves, generally about as large as one's hand, smooth and glossy, of a dark crimson hue, but apt to run off into a pale greenish tint towards the tips; their edges have often little leaves growing on them. It is the Dulse or Dillis (*Rhodymenia palmata*), which is eaten by the poor of our northern shores as a luxury.

This is a showy plant, very beautiful when its tufts of large deep-red fronds are seen in the sea, where the perpetual wash of the waves keeps their surface clean and glossy, but not very suitable for an Aquarium. Its leaves soon decay; spots of orange-colour begin speedily to appear, which increase fast, and, uniting into large patches, slough off in slimy shreds. The appearance of an orange-colour, on crimson or purple weeds, is always a sign of the death of that part, and is the infallible precursor of decay. As soon as it appears, or at least if it begins to increase, the specimen should be ejected without mercy; as the diffusion of the gases from decaying vegetable matter is speedily fatal to most animals.

In deep pools, and narrow clefts near the verge of lowest water, where the overshadowing rock excludes the sun's rays, and imparts a genial obscurity, grow several of our most delicate and beautiful *Algæ*. Foremost among them is the Oak-leaved Delesseria

(*D. sanguinea*), with tufts of crimson leaves, exquisitely thin, much puckered at the edge, and strongly nerved. The *Iridaea*, whose leaves are smooth and leathery, and of a dark brownish scarlet, is often the companion of the former. Here, too, we find the *Phyllophora*, another weed of brilliant red hue, with unnerved leaves much divided, giving origin to other leaves, and these again to others. It is usually much covered with the cells and shrubs of various species of *Polyzoa*, exquisitely beautiful objects for the microscope. The *Gelidium corneum* is another fine red weed, commonly of small size and slender, but prettily fringed with processes all round the edges of the leaves. This and the preceding are very hardy in confinement, and form very suitable plants for an Aquarium.

When we can no longer work at so low a level, we recede to the slopes of the ledges yet uncovered, and find other species in the quiet sheltered pools. A weed is found here, growing in dense mossy patches on the perpendicular and overshadowed edges of the rock, which, when examined, looks like a multitude of tiny oval bladders of red-wine, set end to end in chains. This pretty sea-weed is called *Chylocladia articulata*.

Here also grows the stony Coralline, a plant bearing some resemblance to that just named, in the peculiar jointed form of its growth. Low-lying pools are often incrusted with a coat of stony or shelly substance of a dull purple hue, having an appearance closely like that of some lichens; the crust investing the surface of the rock, and adhering firmly to it, in

irregular patches, which continually increase from the circumference, in concentric zones. This is the young state of the *Corallina officinalis*, which by and by shoots up into little bushes of many jointed twigs, diverging on every hand, or hanging in tufts over the edges of the rock-pools. Young collectors are eager, I perceive, to seize such specimens as are purely white; but this condition is that of death; in life and health the shoots are of the same pale purple hue as the lichenous crust. This plant in both states (for plant it undoubtedly is, though principally composed of lime, and of stone-like hardness) is suitable for a tank, as it survives and flourishes long; and your pieces of rock-work you may select from such places as are covered with the purple crust.

The most valuable plant of all for our purpose is the Sea Lettuce (*Ulva latissima*). Every one is familiar with its broad leaves of the most brilliant green, as thin as silver-paper, all puckered and folded at the edge, and generally torn and fretted into holes. It is abundant in the hollows of the rocks between tide-marks, extending and thriving even almost to the level of high water, and bearing with impunity the burning rays of the summer's sun, provided it be actually covered with a stratum of water, even though this be quite tepid. It therefore is more tolerant than usual of the limited space and profuse light of an Aquarium, where it will grow prosperously for years, giving out abundantly its bubbles of oxygen gas all day long. It is readily found; but owing to the excessive slenderness of its attachment to the rock, and its great fragility, it is not one of the easiest to

be obtained in an available state. The grass-like *Enteromorphæ* have the same qualities and habits, but their length and narrowness make them less elegant. The *Cladophoræ*, however, are desirable ; they are plants of very simple structure, consisting of jointed threads, which grow in dense brushes or tufts of various tints of green. Some of them are very brilliant ; the commonest kind is *C. rupestris*, which is of a dark bluish-green ; it is abundant in most localities.

These are a few of the sorts of sea-plants which are met with in the situations I have described. In order to transfer them to an Aquarium, a portion of the rock on which they are growing must be removed. These plants have no proper roots, and therefore cannot be dug up and replanted like an orchis or a violet, but adhere by a minute disk to the surface of the rock, and, if forcibly detached, die. I therefore bring the hammer and chisel into requisition, and split off a considerable fragment of the solid stone, which then, with the plant adhering to it, is placed in the Aquarium. This is often a difficult, always a delicate, operation ; the rock is frequently so hard as to resist the action of the chisel, or breaks at the wrong place ; sometimes, on the other hand, it is so soft and friable as to crumble away under the implement, leaving only the isolated plant deprived of its attachment ; and sometimes, at the first blow, the sea-weed flies off with the vibration of the shock. Often we have to work under water, where the force of the blows is weakened and almost rendered powerless by the density of the medium, and where it is

next to impossible to see with sufficient clearness to direct the assault.

As the plants are detached, they are placed one by one in security. The finer and more delicate ones, as the *Delesseria* for instance, are immediately dropped into a jar of water; for only a few minutes' exposure of their lovely crimson fronds to the air, would turn them to that dull orange colour already mentioned as the sign of incipient decay. The hardier sorts are laid in the basket,—a layer of damp refuse weed being first put in to receive them,—and covered lightly with damp weed. The degree of moisture thus secured is sufficient to preserve many species from injury for hours. Thus they are brought home.

COLLECTING ANIMALS.—I have been speaking of the haunts of the living *Algae*, and of the manner of procuring them; because in sequence of idea these come first into consideration. But, in point of fact, the search for animals goes on simultaneously with the process just described; the same haunts which are affected by the marine plants conceal various animals; and it is one of the great charms of collecting, that you never know what you may obtain at any moment. The expectation is always kept on the stretch: something new, or at least unthought of, frequently strikes the eye, and keeps the attention on the *qui vive*.

Close examination of the fissures of the pools, of the rough and corroded stones that have been fished up, and even of the sea-plants themselves, reveals many curious creatures of various kinds and forms, each of which, when found, is seized and consigned

to one or other of the jars. The plants often bear the more delicate Zoophytes, as *Coryne*, *Sertularia*, *Campanularia*, &c., growing parasitically upon them; and some interesting Sponges, as *Grantia compressa* and *G. ciliata*. But more generally the sponges are found incrusting the surface of the rocks in the darkest places, especially on the sides of caverns, intermixed with many species of the Polyzoa.

The Sea-Anemones (*Actinia*, &c.) adhere to rocks; the common smooth species (*A. mesembryanthemum*) often high up, exposed to the air; but the rarer kinds generally in the sheltered crannies and basins, in gravelly fissures, or on the under surface of stones. They must be carefully dislodged by inserting the finger-nail beneath the base, and gradually shoving them off; but those sorts that live in holes must be chiselled out.

Many of the Star-fishes, Sea-Urchins, and Sea-Cucumbers are to be procured by turning over loose stones at the lowest tide-level; various species of Annelides haunt the same places, and some of these are of surpassing beauty. Many curious kinds of Crabs and other Crustacea, too, and in spring the elegant Nudibranch Mollusca, reward the labour of stone-turning.

The univalve Mollusca crawl freely over the surface of the rocks, or roam amid the umbrageous foliage of the weeds that fringe the clear pools; whither also many of the lithe and slender worms, and the swimming Crustacea, as the Prawns and their allies, resort. Some of the Bivalve Mollusca burrow into the solid rock itself, and the Acorn Bar-

nacles are seated by thousands on its surface. Most of the burrowing Bivalves, however, are to be dug out of the sand or mud of the flat shore, and many interesting animals are found on the beds of sea-grass (*Zostera*) that grow on such a coast. These are collected by means of a keer-drag, a form of net which I have described, with the mode of using it, at p. 49, *ante*.

DREDGING.—In the previous pages I have also given a full description of dredging and its prolific results, whereby the bottom of the deep sea is scraped and the varied contents brought to light. Multitudes of animals of the highest interest are procured by dredging that the shore-collector would never find; and yet shore-collecting must always be the main resource, at least of the majority.

TRAWLING.—Though this is a mode of fishing too cumbrous and expensive for the amateur generally, the naturalist may occasionally benefit by its wide-sweeping action. I have described it in my "Tenby," pp. 185—198.

Mr. Dempster, of Edinburgh, has recently invented an ingenious improvement on the old trawl, analogous to that which distinguishes the naturalist's from the common oyster-dredge.

The ground-rope is dispensed with; a rod of cast-iron passing across from the heads both above and below the mouth of the net, so that the net is sure to be right, however it fall. The beam is moveable, rising to the edge that happens to be uppermost by its own lightness, while a curtain that stretches from it to another beam in front, to which the bridle

is fastened, prevents the fish from escaping as they rise. Wings on each side, loaded at the bottom, sweep every hole and depression. There are other improvements, which appear to me (judging, however, only from a small model) to fit the trawl for naturalists' use, no less than for that of fishermen. For the former purpose, it might be made small, not wider than a common dredge. The inventor estimates that one made 30 or 36 inches in breadth of beam, would not cost more than 1*l.* 10*s.* or 2*l.*

TOWING.—One more means of obtaining animals remains to be mentioned,—the surface-net. This may be made of stout muslin, in the form of a bag, two feet deep, sewed on a thick brass ring a foot in diameter, which is screwed at the end of a staff six feet long. The staff should be of tough wood, such as hickory or lance-wood. The net is held at the surface of the sea, the collector sitting in a boat rowed gently along. The afternoon and evening of a calm sunny day is most productive, especially in the latter part of summer and autumn, when the lovely *Medusæ*, the little *Beroe*, and many forms of freely swimming ANNELIDA and CRUSTACEA occur in abundance. At frequent intervals, the bag of the net must be reversed and plunged into a glass jar of clear water, when the captives will float off into the vessel.

Again I bid farewell to my courteous reader. Again we have had fellowship together in tracing some of the wonders of an Almighty Hand, but how much remains unexplored! “Lo! these are parts of

his ways, but how slight a whisper is heard of Him !
 But the thunder of his power who can understand ? ”
 (Job xxvi. 14.)

“ Yes ! as a drop of water in the sea,
 All this magnificence in Thee is lost :—
 What are ten thousand worlds compared to Thee ?
 And what am I then ? Heaven’s unnumber’d host,
 Though multiplied by myriads, and array’d
 In all the glory of sublimest thought,
 Is but an atom in the balance weigh’d
 Against thy greatness ; is a cypher brought
 Against infinity ! What am I then ? Nought !

“ Nought ! But the effluence of thy light divine,
 Pervading worlds, hath reach’d my bosom too.
 Yes ! in my spirit doth thy Spirit shine
 As shines the sunbeam in a drop of dew.
 Nought ! But I live, and on hope’s pinions fly
 Eager towards thy presence ; for in Thee
 I live, and breathe, and dwell ; aspiring high,
 Even to the throne of thy divinity :
 For Thou hast deign’d to link thyself with me ! ”

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